

**"STUDIES ON THE MORPHOLOGY, ANATOMY & TAXONOMY
OF DIGENETIC PARASITES OF CAT FISHES OF
BUNDELKHAND REGION"**



THESIS

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JUNE, 2005

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Certify that thesis entitled "Studies on the *Morphology, Anatomy & Taxonomy* of digenetic parasites of cat fishes of Bundelkhand region", submitted by (Smt.) Kalpna Verma for the degree of *Doctor of Philosophy* (Ph. D) in *Zoology* of *Bundelkhand University, Jhansi* embodies the original work done by her. She has worked under my guidance and supervision for more than twenty four months, commencing from the date of her registration.

It is further certified that the data of her put in an attendance of over 200 days in the Department from the date of her registration for Ph.D. degree of the University as required under the relevant ordinances.

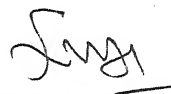


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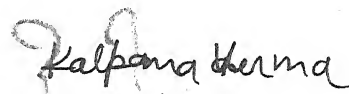
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(SMT. KALPANA VERMA)

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PART - I

GENERAL

INTRODUCTION

Now a days fishes occupy an important nutritive value in human diet. Fishes are related with the economy & ecosystem i.e. why fresh water and marine fishes are the important diet of human food. Different types of fish diseases are reported, but the effect of Helminth parasites much of destruction. Helminth parasites have detrimental effect of fishes in many ways. They damage the various organ of fishes, due to which field of fish production is affected, these parasites also some times affect human being & other animal for which fishes act as a carrier of disease. The success of implementation of a various fishery development programs depends to a certain extent of the intensification of fish parasitological research, as the improvement of fish production can be achieved from healthy fish stock only.

A lot of work have been done about the parasites there have been a lot of literature have been available for the study of Morphology and & economy of parasites of fishes. "So different genus and species of fish-parasites have been studied for the

controlling there adverse effect. Still our knowledge on fish parasites and diseases is very meagre and we have no knowledge of the amount of damage caused and loss incurred in total fish-production and fish products due to parasites and parasitic diseases.

The studies presented in the thesis are based on the study of material collected from extensive of digenetic trematodes from Betwa and Ken rivers passing through the Bundelkhand region only.

The Bundelkhand region has a number of small and large water bodies, lakes, dams and two rivers which provide better fisheries and aquaculture prospects.

This region forms South-east boundary of Uttar Pradesh, extending from 24.21' to 26.42' North latitude and 78.14' to 81.38' East longitude. It is comprised of five districts, namely - Jhansi, Lalitpur, Jalaun, Hamirpur and Banda. The region is surrounded in northern side by the districts of Etawah, Kanpur, Fatehpur and Allahabad of Uttar Pradesh.; in Western side by the districts of Guna, Shivpuri and Data of Madhya Pradesh.; and in

Southern side by Districts of Sagar, Chattarpur, Panna of Madhya Pradesh.

The Betwa and Ken are the only two major rivers of this region which extend from one end of Bundelkhand region to the other. The water remains in them throughout the year. All popular groups of fishes form the bulk of total production of this region. The daily fish-output from this region is 30 to 40 metric tons in off season and 50 to 80 metric tons during the season. The whole collection is exported to different important areas of the country after satisfying the regional requirements. All popular groups of fishes such as major carps, cat fishes, live fishes, feather backs, sheet fishes, eels etc. form the bulk of total production of this region.

The common fresh water fishes of the region namely *Clarias batrachus* (Linn.), *Heteronepeustes fossilis* (Bl.) and species of *Channa*. These include *Channa punctatus* (Bl.), *Channa striatus* (Bl.) and *Channa marulius* (Ham.). Out of the five species of *Channa punctatus* (Bl.) *Channa striatus* (Bl.) and *Channa leucopunctatus* (Bl.) only the above mentioned three

species are available in the water of Mathura district. These fishes are predatory in nature. Since these fishes remain alive for a long period out of water, so they are usually marketed alive and also known as live fishes. These fishes are easy to handle in laboratory. Though these fishes are mostly non-commercial, yet they have their own economic value and great demand due to their high protein, high iron and low fat contents compared to that in caps. *Clarias batrachus* (Linn.) and *H. fossilis* (Bl.) are considered to be highly nutritious and esteemed as food where as species of *Channa* are eaten mostly by poor classes.

Thus efforts have been made to concentrate the work on cat fish and to obtain maximum number of parasites from throughout the period of study.

In order to make the faunistic studies more elaborate and objective, host-parasite relationship has also been studied and analysed statistically, in order to study index of total helminth infection; host-wise analysis; and intensity of infection in trematodes. Such calculations can help considerably in the correct understanding of

the nature and exten of their pathogenic role.

The present findings definitely contribute to the general survey of the parasitic fauna of this region. It may help the pisciculturists in understanding better the effect of parasitization on the fishes, thus helping to increase the production of fish as food to human beings.

HISTORICAL RESUME

Helminth parasites have been known to mankind since Vedic and Post-vedic periods around 800 B.C. as in *Atharvaveda* these worms are referred to as Krimis. Great medical treatises of Charak and Susruta (between 200 B.C. and 200 A.D.) even mentioned detailed treatment of parasites. A detailed account of knowledge of these worms in ancient India is given by Bhaduri, Tiwari and Biswas (1972).

Our present day knowledge of helminth parasitism dates back to 1379, when Jehan-de-Brie (1379) who for the first time discovered fluke *Fasciola*. The first references to trematodes, probably *Fasciola jacksoni* and *Pseudodiscus hawkesi*, from Indian region in modern times is made by Gilchrist, who has worked on them in the years 1841-1846. Later on, Cobbold (1869-1882) wrote a series of papers describing parasites of elephant, cattle and Gangetic dolphin and thus making the beginning of the scientific study of trematode fauna of India.

Bhalerao (1926) was the first Indian helminthologist to give

a boost to Indian helminthology in general and study of trematodes in particular. He was followed by a band of dedicated workers like Mehra, Moghe, Thapar, Lal, Srivastava (H.D.), Chauha, Pande and many others, who contributed much to our present day knowledge of the trematodes from India region. Bhalerao (1930) reviewed the progress of the knowledge of trematodes in India till that time In 1956. Thapar and Chauhan in 1963 also discussed the progress of helminthology in India with special reference to trematodes. Some of the more important contributions in this field include-

Bhalerao (1926, 36); Verma (1927, 36); Chauhan (1940, 49, 54, 55); Srivastava, H.D. (1943, 48); Mehra H.R. (1935, 38, 62, 66); Pande (1937); Patwardhan (1935); Khan (1935), Mehra, R.K. (1941); Kaw (1950); Dayal (1948, 49, 50); Baugh (1949, 50); Gupta (1950, 51, 55, 56); Jaiswal (1957); Jain (1967) and Pandey K.C. (1970);

Helminth parasites of Indian fishes not received the attention they deserve except for the systematics of certain parasites. A perusal of literature shows that following Indian workers have described the

trematode parasites of fishes -

Billet (1899) described *Isoparorchis hyselobagri* from *Wallago attu* and immature forms of the same from *Barbus* for *Channa striatus*, *Notopterus notopterus* and *Mastacebelus armatus* from India.

Southwell (1931) described *Isoparorchis trisimilitubis* which was later renamed as *I. hypselobagri* from the air bladder of *Wallago attu*. Verma (1972) reported *Opisthorchis pedicellata* from the gall bladder of *Rita rita*. He (1935) also recorded gastrostomes from siluroid fishes.

A large number of workers have made substantial contribution of the taxonomy of trematode parasites. These include-

Southwell and Prashad (1918) described *Clinostomum piscidum* and *Nandus*.

Verma (1972) described *Opisthorchis pedicellata* from *Bagarius varrelli* and *Rita rita* from Allahabad .

Thapar (1930) described *Gomtia piscicola* from *Bagarius varrelli* from Lucknow.

Srivastava, H.D. (1930) described *Progonus piscicola* and *Progonus ovocaudata* from *Ophiocephalus punctatus*; *Ophiocorchis lobata* and *Ophiocorchis singularis* from *Ophiocephalus striatus* from Allahabad.

Pande (1934) described *Orientocreadium indicum* from *Heteropneustes fossilis* and *Rita buchanani* from Allahabad. In 1937, he described *Allocreadium handiai* from *Ophiocephalus punctatus*; In 1983, he described *Allocreadium kosia* from *Barbus chilinoides*; *Allocreadium schizothoracis* from *schizothorax micropogan*; *Allocreadium mahaseri* from *Barbus* from Allahabad. Dayal (1949) described *Phyllodistomum vachius* from *Eutropiichthys vacha* from Lucknow and Allahabad.

Bhalero (1941) described *Clinostomum indicum* from *Notopterus notopterus* from Allahabad. In 1942, he described *Clinostomum dasi* from *Saccobranchus fossilis* and *Clinostomum parashadi* from an unidentified fish from

Hydrerabad.

Mehra (1941) decribed *Opisthorchis pedicellata minutus* from *Mystus seenghala* and *Wallago attu* from Allahabad.

Gupta (1950) described *Allocreadium thapari* from Rita rita from Hardoi. In 1951, he described *Phyllodistomum singhiai* from *Mastacembelus armatus* from Lucknow and Sharanpur. In 1953, he described *Haplorchoides seenghali* from *Macrones seenghala*; *Phyllodistomum vittatusi* from *Macrones vittutus*; *Haplorchoides ritai*, *Haplorchoides gomtioensis* from *Silundia gangetica* from Lucknow. In 1956, he described *Allocreadium kamali* from Chela bacaila. *Allocreadium mehrai* from *Rhychobadella aculeata* from Lucknow. In 1963, he described *Allocreadium makundai* from Barbus sarana from Banaras.

Gupta and Verma (1976 Publ. 1977) described *Allocreadium mrigali*, *Allocreadium baranai*, *Allocreadium saranai* from *Cirrhina mrigala*, *Barilius barana* and *Barbus*

sarana respectively.

Kaw (1950) described *Allocreadium nemacheilus* from *Nemacheilus kashmirensis*; *Clinostomum schizothoroxi* from *Oreinus sinatus*, *Schizothorax micropogan*; *Phyllodistomum loossi* from *Schizothorax socinus* from Kashmir.

Jaiswal (1957) described *Phyllodistomum* (Catroptoides) *Indianum* from *Heteropneustes fossilis* and *Phyllodistomum parorchium* from *Glossogobius (Gobius) giuris*; *Euclinostomum chanai* from *Ophiocephalus punctatus*; *Clinostomum macrosomium* from *Mastacembelus armatus* from Hyderabad.

Saksena (1958) described *Orientocreadium raipurensis*, *Orientocreadium dayali* from *Claris batrachus*; *Allocreadium spindala* from *Mastacembelus armatus* from Raipur. In 1960, he described *Orientocreadium umadasi* from *Clarias batrachus* from Raipur.

Srivastava P. S. (1960) described *Allocreadium* ophiocephali from *Ophiocephalus punctatus* from Raipur.

Motwani and Srivastava (1961) described *Phyllodistomum* chauhani from *Mystus* tor and *Mystus seenghala*; *Phyllodistomum tripathi* from *Bagarius bagarius* from India.

Raj (1962) described *Al locreadium dolifusi*, *Allocreadium singhi*, *Allocreadium hirnai* from *Basrbus tor* from the River Hiran near Katangi and Sehora (M.P.).

Srivastava, C.B. (1962) described *Pycnadena komiyai* from *Oxygaster gora* from India.

Agarwal (1964) described *Allocreadium heteropneustusius* from *Heteropneustes fossils*; *Haplorchoides macroni* from *Macrones seenghala* from Lucknow. In 1966, she described *Genarchopsis punctati* from *Ophiocephalus punctatus* from Lucknow.

Kakaji (1969) described *Genarchopsis cameroni* from *Mystus seenghala*; *Allocreadium catlai* from *Catla catla*;

Genarchopsis cuchiai from *Amphipnous cuchai* from Lucknow.

In the same year, she described *Alloreadium guptai* and *Allocreadium fasciatusi* from *Rita rita* and *Trichoquaster fasciatus*, respectively from Varanasi.

Fotedar (1969) described *Phyllordistomum megacotyle* from Garra mullya from Kashmir.

Pande, B.P. and Shukla, R.P. (1976) described *Haplorchoides pearsoni* and *Haplorchoides mehrai* from Channa *punctatus* and *Mystus vittatus*, respectively from Lucknow.

Gupta V. and Puri, M. (1979, Publ. 1980) described *Allocreadium calbassii*, *Allocreadium manateri* from *Labeo calbasu*, *Anabas tesudineus*, respectively from Lucknow.

In Madhya Pradesh also, lot of work was done at Jaipur, Raipur, Rewa, Ujjain and Gwalior by Singh, Agarwal Dwivedi, Raj, Saxena, Jain Khoche, Johri, Dandotia and others. However, little work has been done on the helminth parasites of fishes of

Bundelkhand region.

From the foregoing account, it is evident that considerable progress is being made in the knowledge of helminth fauna and its taxonomic study of this country, but very little work has been infection.

The important contributions in this field have been made by Srivastava, C.B. and Mukherjee, G.D. (1986); Siddiqui A.H.; Nizami, (1982), Dondotia, M.R. (1984, 1992, 1994) and others. Still a wide lacuna is left in this field considering the richness of fauna fo parasite helminthes.

MATERIAL & METHOD

The host fish were collected from rivers Betwa and Ken, dams and ponds and other local fresh water bodies of Bundelkhand region. Fishes were also purchased from local fish markets.

This host fish was kept alive in aquaria in the laboratory and then freshly killed, dissected and examined at convenience. A thorough search was done to determine the whereabouts of parasites. Various organs particularly body cavity, stomach, duodenum, intestine, rectum, gall bladder and kidneys were carefully examined in paritidish under the low power binocular.

Soon after collection, the trematodes were thoroughly washed and kept in saline water. They were studied alive and observations were made regarding the colour and movements of body, spines on the body, oral and ventral suckers, cirrus and metratrem, excretory bladder and its branches.

For fixation 5-10% formaline was used. For whole mounts, preservation in formaline for longer periods gave good results. For preparing whole mount, precaution was taken to avoid over or under pressure.

For preparing whole mount of trematodes, after fixation and through washing in water, worms were dehydrated and stained in

Borox Carmine, then cleared in xylene and finally mounted in DPX.

The drawings of the whole mounths were made with the help of camera lucida at a suitabel magnification.

To record the seasonal incidence, the fishes were examined at regular intervals from Jan. 2003 to March 2005. In all, 75 fishes per month with an average of 15 fishes per month of each species were examined. A total of 1800 fishes were collected was studied during two years period. The data collected was studied and statistically anaysed. This index of total helminth infection (Trematodes), host wise analysis, overall incidence, level and intensity of parasitization seasonal incidence and intensity of infection were calculated and analysed.

PHYSIOGRAPHY OF BUNDELKHAND REGION

The region (24° - 26° N and 78° 10' - 81° 30' E) bounded by Yamuna in the north, escraped ranges of Vindhyan Plateau in the south, the Chambal river in the south-east, is known as Bundelkhand (Singh, 1971). It comprises of five districts Banda, Hamirpur, Jalaun and Lalitpur of Uttar Pradesh and four Chhatarpur, Datia, Panna and Tikamgarh of Madhya Pradesh together with Lahar (Bhind district) and Bhandar tahsil (Gwalior district) in the north - west. The key-note of Bundelkhand topography is its smooth and undaulating character of which spate and Learnmouth (1954) give the term senile topography. The entire region is marked by subdued topography. The peculiar features of immense geomorphic interest in this region are the long, narrow, serrated edges termed as quartz reefs and Dolerite dykes. The former are very conservative in their direction and persist at long distances like fort walls, and they have frequently intercepted the courses of regional streams, thereby providing suitable sites for a large number of water bodies and semiartificial tanks, giving enough security to agriculture and pisciculture. By and

large, Bundelkhand is a distinct geographical region of India. It has further divisions on the basis of their physical, social and economic distinctiveness (Siddiqui, 1966). The major divisions are :

A. Bundelkhand plain

- (i) Revine belt
- (ii) Jalaun plain
- (iii) Hamirpur plain
- (iv) Banda plain west and east

B. Bundelkhand upland

- (i) Bundelkhand Gneissic Region
- (ii) Bundelkhand Vindhyan Plateau
(consisting of Banda, Chitrakoot plateau)

CLIMATE :

Centrality of the region imposes on it the features of a transitional climate between the maritime climate of the east coast (Bay of Bengal) and the tropical continental dry type climate of the west (Rajasthan) (Singh, 1971). It experiences excessive heat during

summers (March - June) and mild cold during the winters (November - February). Bundelkhand region of ten registers the largest number of sunstrokes every year owing probably to intense terrestrial radiation and lack of haziness in the sky.

TEMPERATURE

The mean atmospheric temperature in the summers varied from 25.95° - 34.65°C (March - June) but actual temperature was much higher and mercury often recorded 42.4°C during May when the heat became oppressive accompanied by the scorching winds. Relative humidity varied from 16.6% - 67.0%.

It is seen that with the advent of monsoons by the middle of June, the temperature falls abruptly, giving a sense of general relief. The mean atmospheric temperature during the rainy season was between 28.6°C in August and 35.5°C in July, the maximum temperature being 34.2°C and minimum 23.1°C during the month of October. The relative humidity varied from 73.6% - 82.9%, so that the typical weather during July and August was muggy and sultry. From October onwards to February the weather gradually crystallises

into a pleasant and invigorating winter season with the mean temperature varying from 21.25°C in November to 15.5°C in January, the maximum temperature being 30.1°C in November, and minimum 90.2°C in December.

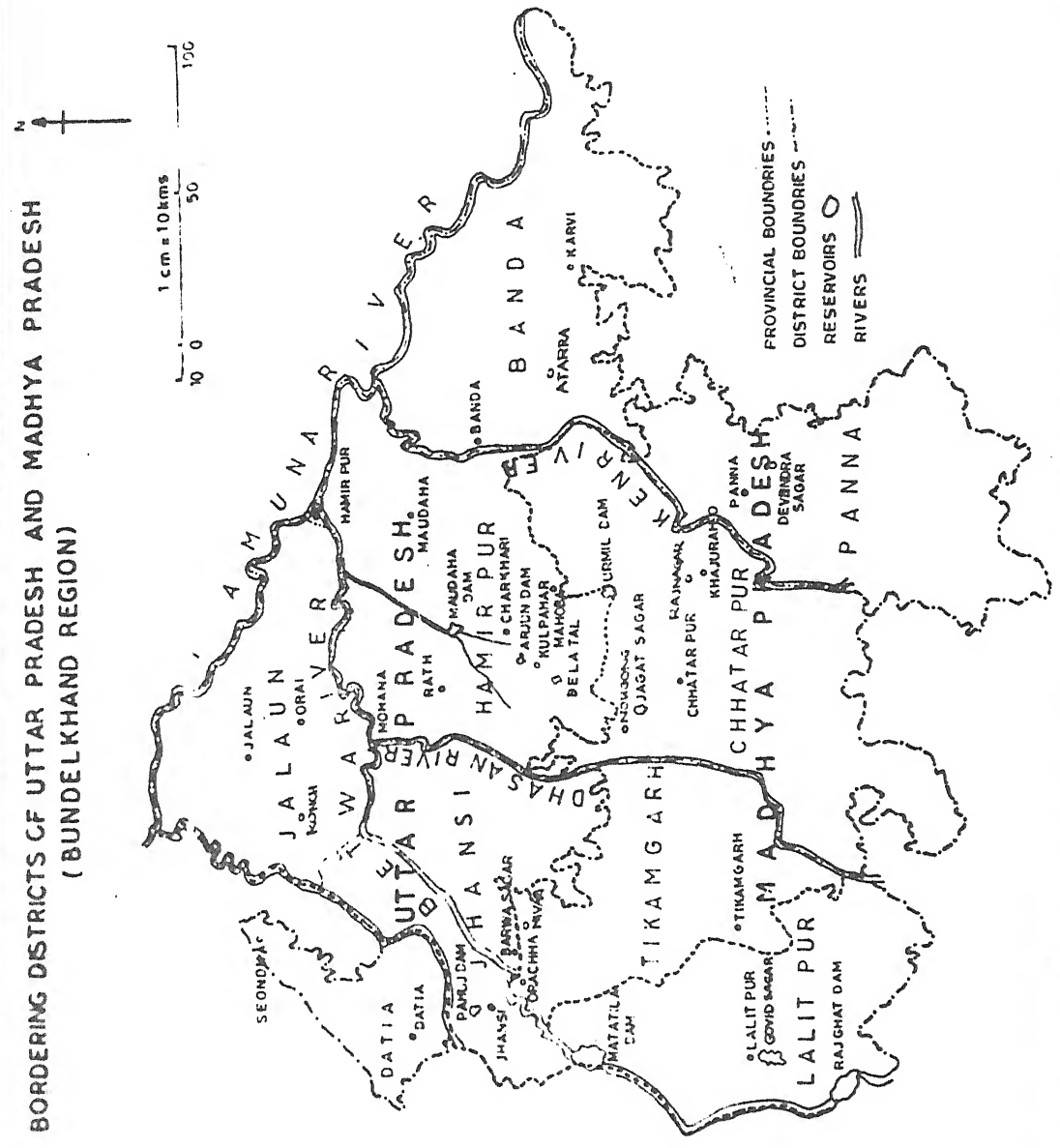
RAINFALL :

The Bundelkhand gets rains due to cyclonic storms forming in the north of Bay of Bengal and advancing along this trough. July and August were the months with heaviest rainfall (189.1 mm - 303.6 mm). Winter showers were generally experienced during the months of January and February (1.6 - 2.8 mm).

Figure

Map of Bordering districts of Uttar Pradesh and Madhya Pradesh
(Bundelkhand Region)

**BORDERING DISTRICTS OF UTTAR PRADESH AND MADHYA PRADESH
(BUNDELKHAND REGION)**



PART - II
SECTION-A

**MORPHOLOGY, TAXONOMY
OF CERTAIN DIGENETIC
PARASITE**

Opisthorchis Pedicellata Verma, 1927

(Fig. A, B, C)

Host	: Heteropheustes fossils
Locality	: River Keni, Panna, M.P. River Betwaa, Orchha, M.P.
No. of Fishes Examined	: 58
No. of Fishes Infected	: 6
Location	: Gall Bladder
No. of Specimens Collected	: $3 + 2 + 1 + 2 + 4 + 3 = 15$

DESCRIPTION

Body slender, elongate with narrower anterior and tapering posterior ends, covered with backwardly directed pointed spines. Oral sucker sub-terminal, oval or rounded. Ventral sucker pre-equatorial, spherical, larger than oral sucker. Pre-pharynx very small, visible in living specimens, seems to be absent in fixed forms. Pharynx globular or oval, muscular. Oesophagus variable in length. Intestinal caeca reaching up to hind end of posterior testis. Testes irregular or lobed, tandem, located in posterior part of body, more or less equal in size. Vesicula seminalis long, thin walled, coiled,

extends from little posterior or ventral sucker up to pre-acetabular region. Ovary pre-testicular, pear-shaped or oval. Receptaculum seminis pear-shaped, variable in size, located at the level of ovary towards the left side. Uterus interacecal, coils horizontally placed, extending in between ventral sucker and ovary, opens at genital pore by a metraterm. Shell glands numerous, surrounded the ootype. Laurer's canal present. Egg oval, yellow, operculated. Genital pore median, pre-acetabular. The vitelline follicles extend from little anterior or posterior to ventral sucker up to middle of ovary or up to level of anterior testis, two vitelline ducts unite with each other to form a yolk reservoir which opens at ootype. Excretory bladder S-shaped, excretory pore terminal.

Body length, 4.45 - 6.12; width, 0.98 - 1.24; oral sucker, 0.21 - 0.24 x 0.20; ventral sucker, 0.22 - 0.24 x 0.20 - 0.28; pre-pharynx, 0.05 - 0.07 x 0.04 - 0.06; pharynx, 0.09 - 0.11 x 0.11 - 0.12; oesophagus, 0.13 - 0.18 x 0.04 - 0.06; anterior testis, 0.41 - 0.46 x 0.44 - 0.48; posterior testis, 0.31 - 0.41 x 0.48 - 0.63; vesicula seminalis, 0.48 - 0.61 x 0.05 - 0.06; ovary, 0.30 - 0.38 x 0.28 - 0.38;

receptaculum seminals; 0.27 - 0.41 x 0.13 - 0.15; egg, 0.021 - 0.224 x 0.101 - 0.015. (All measurement were taken in mm.)

DISCUSSION

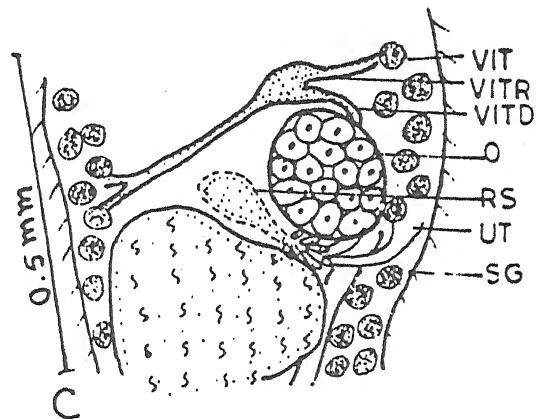
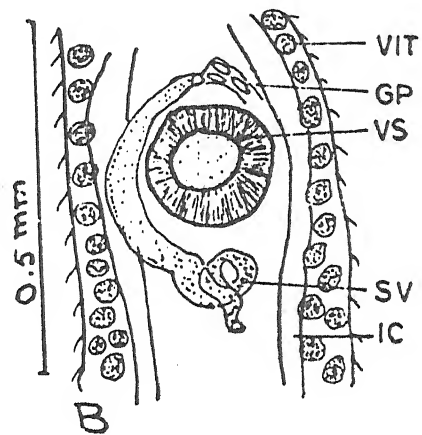
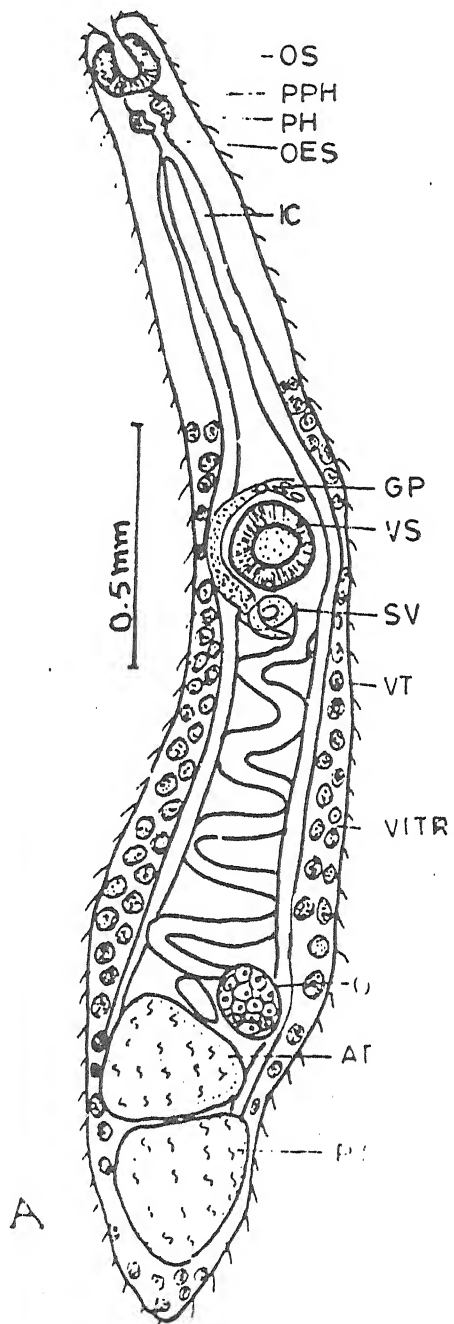
The present form belongs to Opisthorchis pedicellata Verma, 1927 and is also being recorded from Bundelkhand region belong to Madhya Pradesh, India. Earlier, Verma (1927) has described this species from the gall bladder of Bagarias bagarias at Allahabad. This has also been redescribed by Kumar (1979) from Bagarias bagarias at Varanasi and Agrawal (1980) at Jhansi and Banda.

However, the present description differs from the original account of Verma (1927) and also of Kumar (1979) and Agrawal (1980) in the ratio of suckers and in the extension of vesicula seminalis and vitelline follicles. These differences appear to be individual variations.

Figure

Opisthorchis pedicellata Verma, 1927

- A. Dorsal View
- B. Cirrus sac enlarged (drawn live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)



Tremiorchis ranarum Mehra and Negi, 1926

(Fig. A, B, C, D)

Host	:	<u>Rita rita</u> (Ham.)
Locality	:	Fish market, Hamirpur, U.P.
No. of Fishes Examined	:	35
No. of Fishes Infected	:	2
Location	:	Intestine
No. of Specimens Collected	:	1 + 1 = 2

DESCRIPTION

Body elongated, spinous, with narrow anterior and blunt posterior ends. Oral sucker sub-terminal, oval or rounded. Ventral sucker pre-equatorial, rounded, larger than oral sucker. Pepharynx absent. Pharynx globular, muscular. Oesophagus long, variable in length. Intestinal caeca extending up to the margin of anterior testis. Testes oval or notched, symmetrical, diagonally placed; anterior testis smaller than the posterior one. Cirrus sac extends from anterior margin of ovary up to below the level of intestinal bifurcation, curved, enclosing an oval vesicula seminalis, a wide pars prostatica

surrounded with prostate gland cells and a long ejaculatory duct. Ovary spherical, pre-equatorial, smaller than the testes. Receptaculum seminis oval, post-ovarian. Uterus occupies whole of the hind body, opens at genital pore by a prominent metraterm. Shell glands numerous, surround the ootype. Laurer's canal present. Egg oval, non-operculated. Genital pore post-bifurcal, sub-median, just in front of ventral sucker or close to intestinal bifurcation. Vitelline follicles extend from middle of ventral sucker or little posterior to ventral sucker either up to anterior or up to posterior end of anterior testis, two vitelline ducts unite to form a yolk reservoir. Excretory baldder Y-shaped, excretory pore terminal.

Body length, 3.42 - 3.49; width, 0.71 - 0.79; oral sucker, 0.20 - 0.26 x 0.17 - 0.24; ventral sucker, 0.20 - 0.26 x 0.21 - 0.28; pharynx, 0.12 - 0.15 x 0.09 - 0.10; oesophagus, 0.38 - 0.52 x 0.10 - 0.12; anterior testis, 0.26 - 0.28 x 0.21 - 0.25; posterior testis, 0.35 - 0.40 x 0.29 - 0.34; cirrus sac, 0.65 - 0.78 x 0.09 - 0.12; vesicula seminalis, 0.27 - 0.38 x 0.06 - 0.08; pars prostatica, 0.12 - 0.18 x 0.04 - 0.06; ejaculatory duct, 0.12 - 0.15 x 0.03 - 0.04; ovary, 0.19 -

0.09 - 0.11; egg, 0.02 x 0.01. (All measurement were taken in mm.)

DISCUSSION

The genus *Tremiorchis* Mehra and Negi, 1926 was included in the sub-family plagiorchinae Pratt, 1902 of the family Plagiorchildae (Luhe, 1901) Ward, 1917. Subsequently, workers like Bhalerao (1926), Ejmont (1928), Mehra (1937), Yamaguti (1958), Agrawal (1966), Fotedar (1970) and Sinha and Sahay (1971) etc. have also followed Mehra and Negi, 1926. However, Yamaguti (1971) revised this classification and removed the genus Tremiorchis from the family Plagiorchildae to include it in the sub-family Brachycoellinae Looss, 1899 of the family Brachycoeliidae Johnston, 1912. Recently, Kalyankar and Palladwar (1977) have also follwed Yamaguti (1971) and retained the genus under the sub-family Brachycoeliinae. The character of the Genus Termiorchis including the excretory system, show its close resemblance with several other genera of the sub-family Brachycoellinae of the family Plagiorchidae.

The species of genus Tremiorchis Mehra and Negi, 1926 have been mainly reported from amphibian hosts (frogs) by a number

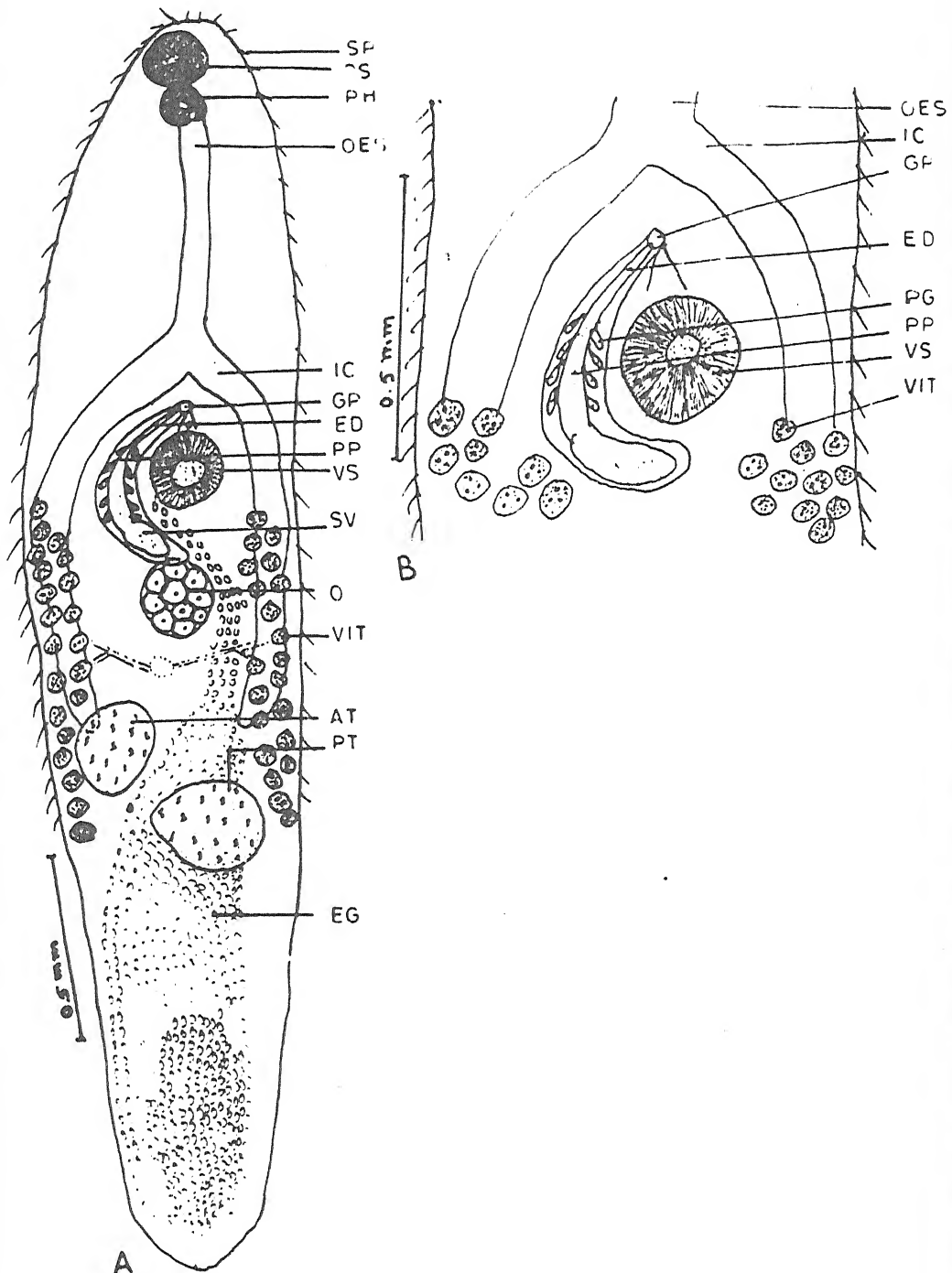
of Indian workers except T. Vanaprum Verma, 1930 which has been reported from a reptilian host. Kumar (1979) recorded Tremiorchis raparum from a piscine host, Channa marulius (Ham.) and Agrawal (1980) from Puntius sarapa (Ham.) at Jhansi. The present report of T. Ranarum is also from a piscine host Rita rita (Ham.) at Hamirpur.

Since earlier workers like Bhalerao (1926), Singh (1954), Bhardwaj (1963), Agrawal (1966), Fotedar (1970) Ali and Karyakarte (1970), Sinha and Sahay (1971), Karyakarte (1972) and Pande (1975) have recorded variations in.

Figure

Tremiorchis ranarum Mehra & Negi, 1926

- A. Ventral view
- B. Cirrus sac enlarged (drawn live specimen)



Allocreadium mahaseri Pande, 1938

(Fig. A, B, C, D)

Host	: <u>Mystus seenghala</u>
Locality	: Benisagar, Panna, M.P.
No. of Fishes Examined	: 80
No. of Fishes Infected	: 4
Location	: Intestine
No. of Specimens Collected	: 2 + 2 + 1 + 1 = 6

DESCRIPTION

Body elongated, smooth, with rounded anterior and narrow or blunt posterior ends. Oral sucker sub-terminal, rounded. Ventral sucker pre-equatorial, rounded, more or less equal or larger than oral sucker. Pre-pharynx very short. Pharynx globular, muscular. Oesophagus short, tubular. Intestinal caeca reaching a little behind to posterior testis. Testes oval, rounded or slightly irregular, post-equatorial, more or less equal in size. Cirrus sc lying on right side from mid level of ventral sucker to the level of intestinal bifurcation, elongated, encloses a bipartite or S. shaped vesicula seminalis,

tubular pars prostatica surrounded with a number of prostate gland cells and a narrow ejaculatory duct. Ovary spherical or oval, pre-equatorial. Receptaculum seminis pear-shaped or sac-like, Lies in between ovary and anterior testis. Uterus extends in between anterior and ventral sucker. Shell glands numerous, surround the ootype. Laurer's canal not seen.

Egg oval, yellow, operculated. Genital pore at the level or near intestinal bifurcation. Vitelline follicles extend from posterior end of ventral sucker up to hind end of body, two vitelline ducts unite before opening at ootype. Excretory bladder tubular, excretory pore terminal.

Body length, 1.19 - 2.56; width, 0.42 - 0.65; oral sucker, 0.20 - 0.27 x 0.21 - 0.25; ventral sucker, 0.22 - 0.29 x 0.21 - 0.28; pre-pharynx, 0.005 - 0.01; pharynx, 0.08 - 0.12 x 0.07 - 0.12; oesophagus, 0.10 - 0.12 x 0.04 - 0.05; anterior testis, 0.20 - 0.26 x 0.21 - 0.28; posterior testis, 0.17 - 0.25 x 0.19 - 0.27; cirrus sac, 0.25 - 0.36 x 0.07 - 0.11; vesicula seminalis, 0.11 - 0.14 x 0.04 - 0.06; ovary, 0.16 - 0.18 x 0.14 - 0.19; receptaculum seminis, 0.23 -

0.28 x 0.08 - 0.12; egg, 0.080-0.094 x 0.054 - 0.062 (All measurements were taken in mm.)

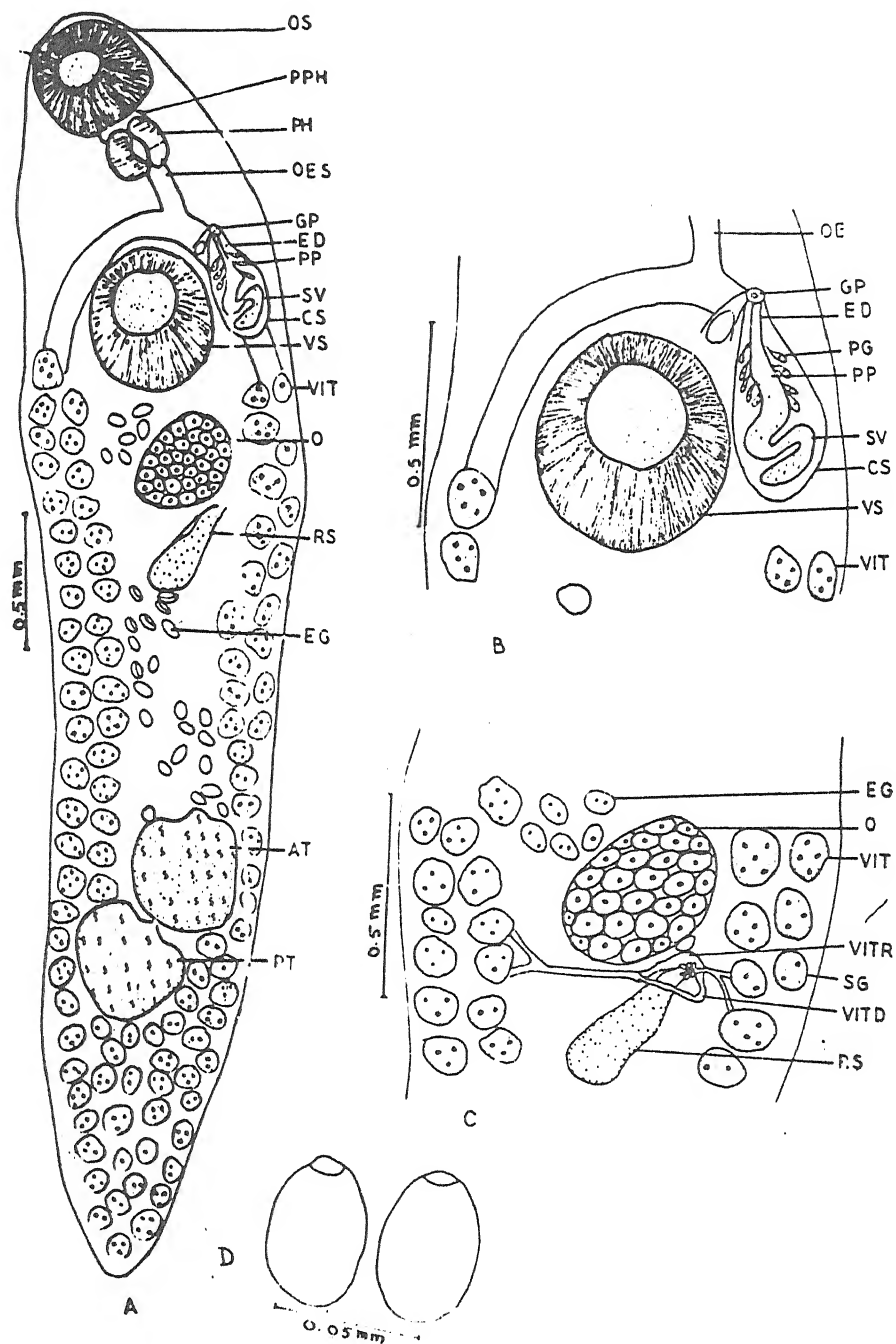
DISCUSSION

The present form belongs to Allocreadium mahaseri Pande, 1938 and is recorded for the first time from the intestine of Mastacembelus armatus (Lac.) from Bundelkhand region. It differs slightly in the shape of gonads, in the extension of cirrus sac and in the position of genital pore from the original account of Pande (1938). However, these differences are considered as individual variations.

Figure

Tremiorchis ranarum Mehra & Negi, 1926

- A. Dorsal view
- B. Cirrus sac enlarged (drawn live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Asymphylogadora indica Srivastava, 1936

(Fig. A, B, C, D)

Host	:	<u>Mystus vittatus</u>
Locality	:	Dhuwela tank, Chhatarpur, M.P.
No. of Fishes Examined	:	48
No. of Fishes Infected	:	4
Location	:	Intestine
No. of Specimens Collected	:	4 + 2 + 5 + 5 = 16

DESCRIPTION

Body elongated, aspinose, with blunt anterior and tapering posterior ends. Oral sucker sub-terminal, oval. Ventral sucker pre-equatorial, rounded, equal or slightly smaller or larger than oral sucker. Pre-pharynx absent or very short. Pharynx globular, muscular. Oesophagus long, curved or straight. Intestinal caeca extend up to the level of testis. Testis elongated, oval post-equatorial. Cirrus sac well developed elongated, extends from little in front of ootype, reaching up to anterior level of ventral sucker, enclosing tubular vesicula seminalis, a short pars prostatica, surrounded with prostate

gland cells and a long spinose ejaculatory duct erected out side. Ovary median, oval or rounded, post-equatorial, smaller than testis. Receptaculum seminis elongated, at mesial side of ovary. Uterus occupies whole of the hind body, opens at genital pore by a metraterm. Numerous shell glands surround the ootype. Egg. oval, non-operculated, without spines or processes. Genital pore laterally placed at the anterior level of ventral sucker. Vitelline follicles extracaecal, extend on each side from posterior level of cirrus sac to anterior level of testis, two vitelline duets unite to form a yolk reservoir which opens at ootype by a common vitelline duct.

Body length 1.87 - 1.91; width 0.62 - 0.64; oral sucker 0.16 - 0.18 x 0.18 - 0.21; ventral sucker, 0.17 - 0.22 x 0.18 - 0.21; pre-pharynx, 0.02 - 0.05 x 0.03 - 0.06; pharynx, 0.06 - 0.10 x 0.08 - 0.01; oesophagus, 0.24 - 0.31 x 0.04 - 0.06; testis, 0.30 - 0.31 x 0.18 - 0.20; cirrus sac, 0.32 - 0.36 x 0.66 - 0.12; vesicula seminalis, 0.21 - 0.23 x 0.06 - 0.07; pars prostatica, 0.06 - 0.08 x 0.05 - 0.06; ejaculatory duct, 0.06 - 0.08 x 0.03 - 0.04; cirrus, 0.01-0.13 x 0.03 - 0.06; ovary, 0.20 x 0.22 x 0.13 - 0.16; egg, 0.018 - 0.023 x 0.012 -

0.17 (All measurements were taken in mm.)

DISCUSSION

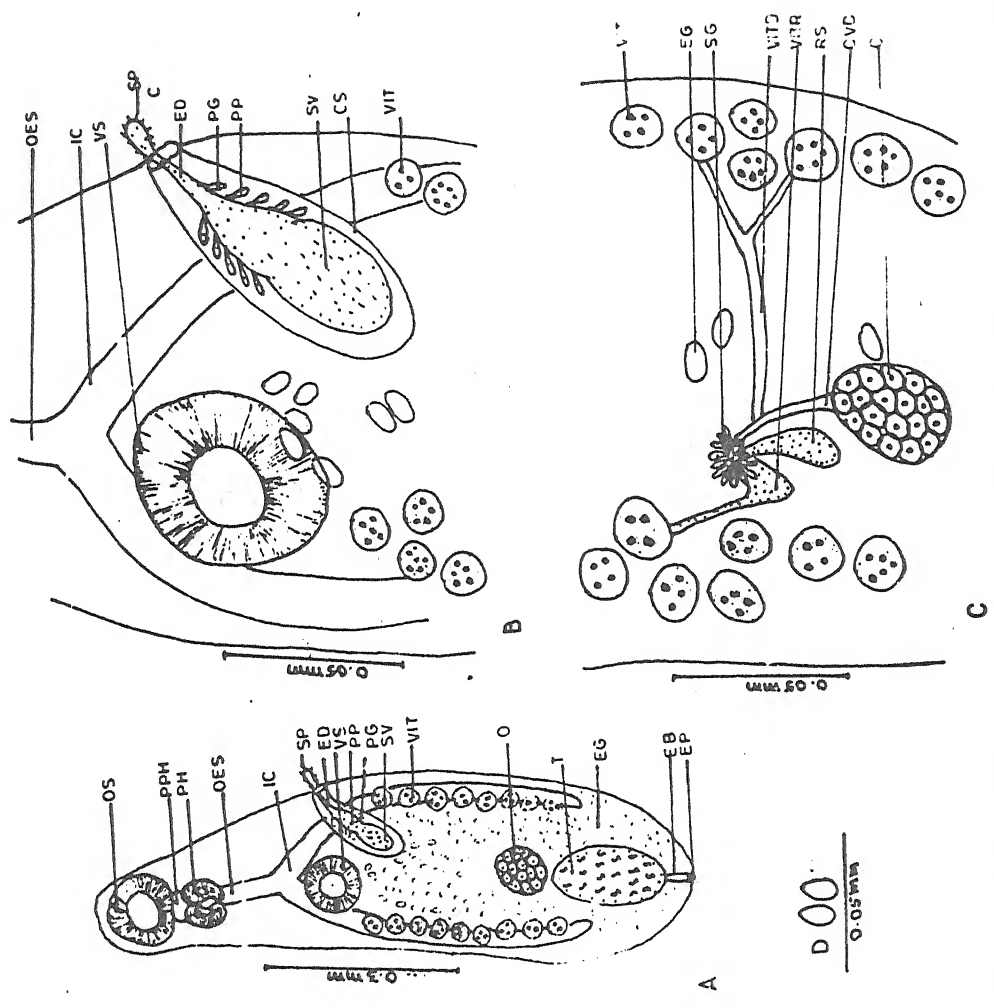
Rai (1971) has made A. indica, A. kedrai and A. ritai synonyms of A. tincae (Modeer, 1790) Luhe, 1909. However, Pandey (1975) retained A. indica as valid species.

It slightly differs from the account given by Srivastava (1936) and Pandey (1975) in the extension of cirrus sac.

Figure

Asymphylodora indica Srivastava, 1936

- A. Dorsal view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Phyllodistomum vittatusi Gupta, 1953

(Fig. A, B, C, D)

Host	:	<u>Wallago bleekeri</u>
Locality	:	Fish market, Ratch, Hamirpur, U.P.
No. of Fishes Examined	:	58
No. of Fishes Infected	:	3
Location	:	Intestine
No. of Specimens Collected	:	1 + 1 + 1 = 3

DESCRIPTION

Body smooth, with narrow anterior and expanded posterior ends. Oral sucker oval, sub-terminal, larger than ventral sucker. Ventral sucker rounded, situated in anterior third of body. Pre-pharynx absent. Pharynx absent, Oesophagus short. Intestinal caeca broad, terminate a little in front of the hind end. Testes larger or smaller than ovary, irregular, intercaecal, tandem obliquely one behind the other. Cirrus sac absent. Vesicula seminalis free in parenchyma, opens into a small vesicular pouch into which uterus also opens. Ovary oval, situated on the left side of the vitelline gland. The uterus arises from the posterior side of ootype between the vitelline ducts,

runs backward, fills up nearly all the space of the body posterior to vitelline gland, forming numerous coils, anteriorly runs dorsal to the ventral sucker to open into the small circular genital pouch which opens outside at the genital pore lies between intestinal bifurcation and the ventral sucker. The vitelline gland consists of two lobed follicles lying at some distance behind the acetabulum, symmetrically one on either side of the ootype, intercaecal in position. Excretory bladder tubular, excretory pore terminal.

Body length 4.81 - 5.52; width, 3.15 - 3.69; oral sucker, 0.46 - 0.49 x 0.26 - 0.29; ventral sucker, 0.31 - 0.34 x 0.30 - 0.32; oesophagus, 0.40 - 0.45 x 0.08 - 0.10; vesicula seminalis, 0.21 - 0.24 x 0.05 - 0.06; ovary, 0.42 - 0.45 x 0.31 - 0.35; egg, 0.018 - 0.019 x 0.011 - 0.012 (All measurements were taken in mm.)

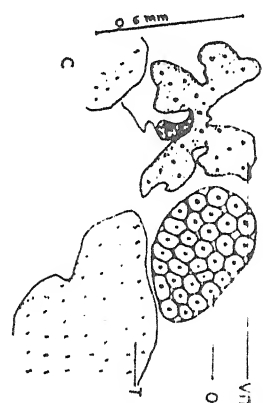
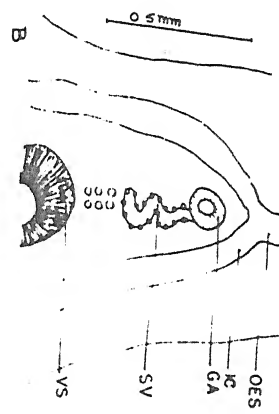
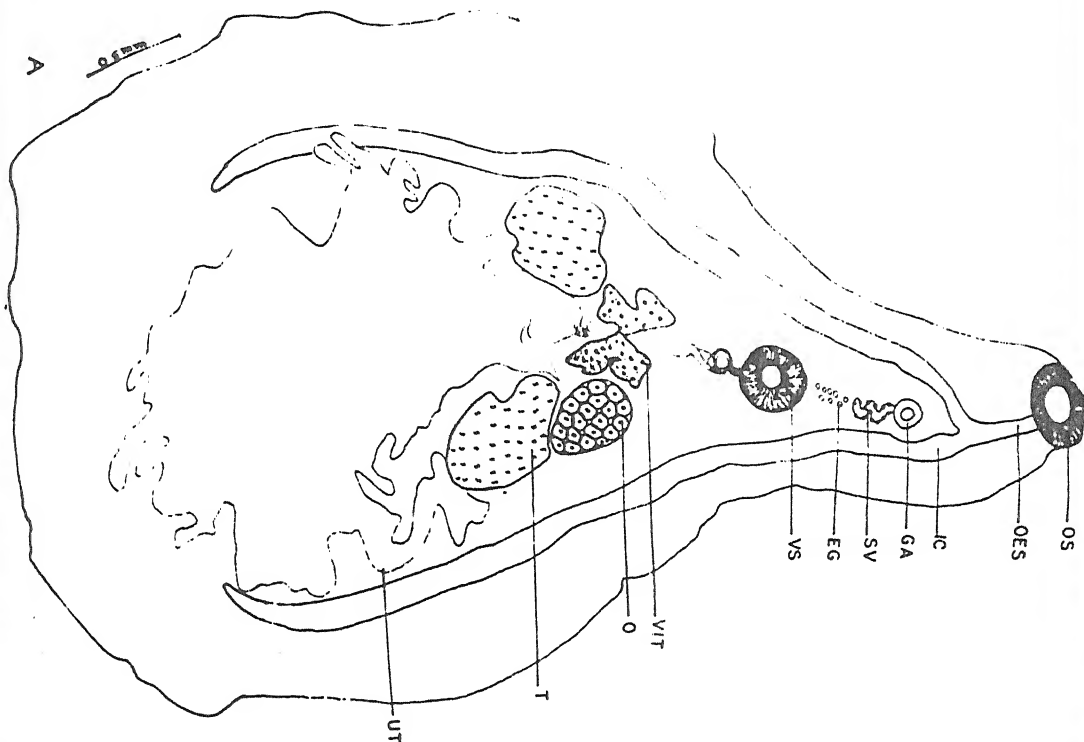
DISCUSSION

The present form belongs to Phyllodistomum vittatusi Gupta, 1953 but slightly differs in the size of oesophagus and testes being larger than ovary. These are considered as individual variable features. This is also being recorded from Rath, Hamirpur.

Figure

Phyllodistomum vittatusi (upto, 1953)

- A. Dorsal view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Opisthorchis bandai n. sp.

(Fig. A, B, C, D)

Host	:	<u>Rita rita</u>
Locality	:	Fish market, Banda, U.P.
No. of Fishes Examined	:	57
No. of Fishes Infected	:	4
Location	:	Gall bladder
No. of Specimens Collected	:	2 + 3 + 2 + 1 = 8

DESCRIPTION

Body elongated, with blunt anterior and posterior ends; covered with small backwardly directed spines up to posterior end of ovary, numerous anteriorly, spares posteriorly and absent in posterior region. Oral sucker sub-terminal, oval. Ventral sucker pre-equatorial, spherical, smaller than oral sucker. Pre-pharynx short, pharynx oval, muscular. Oesophagus short. Intestinal caeca reaching up to the end of body. Testes triangular, tandem, located in posterior region of body; anterior testis slightly larger than the posterior testis. Cirrus sac absent. Vesicula seminalis thin walled, extending from middle of body up to anterior end of ventral sucker. Ovary -

pretesticular, median, spherical. Receptaculum seminis sac-like, larger than ovary, located in between anterior testis and ovary. Uterus arises from right side of ootype, intercaecal, forming simple loops. Metraterm short, open at genital pore. Laurer's canal present. Egg, oval, yellow, non-operculated. Genital pore median, pre-acetabular. Vitelline follicles extend from two vitelline ducts unite with each other before opening at ootype. Excretory bladder straight, extends anterior to ovary, excretory pore terminal.

Body length, 1.71 - 2.25; width, 0.29 - 0.39; oral sucker, 0.09 - 0.10 x 0.09 - 0.11; ventral sucker, 0.10 - 0.13 x 0.11 - 0.12; pre-pharynx, 0.13-0.18 x 0.03 - 0.05; pharynx, 0.06 - 0.08 x 0.05 - 0.07; oesophagus, 0.12 - 0.15 x 0.03 - 0.04; anterior testis, 0.22 - 0.28 x 0.15 - 0.17; posterior testis, 0.19 - 0.21 x 0.15 - 0.17; vesicula seminalis, 0.85 - 1.00 x 0.05 - 0.09 ; ovary, 0.12 - 0.15 x 0.10 - 0.14; receptaculum seminis, 0.12 - 0.14 x 0.08 - 0.11; egg, 0.015 - 0.025 x 0.008 - 0.012 (All measurements were taken in mm)

DISCUSSION

The genus Gomtia was established by Thapar (1930) with

G. Discicola as type species from Bagarias bagarias. Mehra (1941) considered it as synonym of the genus Opisthorchis Blanchard, 1895 and named it as O. gomtia (Thapar, 1930). Subsequently, Dayal (1949) and Gupta (1955) retained the genus Gomtia as valid one on the basis of shape and position of excretory stem but later on workers like - Bisseru (1957), al and Pandey (1965) and Rai (1971) have supported the view of Mehra (1941), Dayal (1949) also added two species viz. G. gagatia and G. lucknowia from the fishes of Lucknow. Rai (1971) pointed out that the main stem of excretory bladder is dorsal to the testes, slightly sigmoid and not truly S-shaped. He also regarded O. mehrai Agrawal, 1959 and O. thapari Agarwal, 1959 as synonyms of O. pedicellata. Kumar, 1979 also added one species O. dayali from Rita rita. The author agrees with Rai (1971) and considered the genus Gomtia as synonyms of the genus Opisthorchis. Henceforth, all the three species of Gomtia are now considered viz. G. gagatia as O. gagatia, G. lucknowia as O. lucknowia and G. piscicola as O. gomtia.

Thus the species of *Opisthorchis* which are reported from siluroid fishes of India are - *O. pedicellata* Verma, 1927 from gall bladder of *Bagarias bagarias* and *Rita rita*; *O. pedicellata minuta* Mehra, 1941 from the gall bladder of *Mystus seenghala* and *Wallago attu*; *O. gomtia* (Thapar, 1930) Mehra, 1941 from the intestine of a *Bagaries bagarias*; *O. gagatia* (Dayal, 1949) Rai, 1971 from the intestine of *Gagatia cenia* : *O. lucknowia* (Dayal, 1949) Rai, 1971) from the intestine of *Mystus vittatus* and *O. davalii* (1970) have mentioned *O. pedicellata intermedia* from gall bladder of *Rita rita* and *matacembelus armatus* as sub-species of *O. pedicellata*.

The present form comes closer to *O. pedicellata minuta* in having small pre-pharynx, short oesophagus and further resembles with *O. pedicellata*, *O. gorakhpurensis*, *O. dayali* in the extension of intestinal caeca but differs from all other forms in the extension of vitelline follicles and cuticular spines.

Key to the Species of the genus Opisthorchis Blanchard, 1895.

1. Intestinal caeca reaching upto hind end of body : 2
 Intestinal caeca reaching upto hind end of anterior testis or slightly beyond it : 3
2. Testes lobed : O. pedicellata Verma, 1927
 Testes entire : 4
3. Oral sucker smaller than ventral sucker : 5
 Oral sucker equal to ventral sucker : O. lucknowia (Dayal, 1949) Rai, 1971
4. Vitelline follicles extend from posterior end of vesicula seminalis to middle of anterior testis : O. dayali Kumar, 1979
 Vitelline follicles extend from posterior end of ventral sucker up to posterior margin of ovary : O. pedicellata minuta Mehra, 1941
 Vitelline follicles extend from posterior end of ventral sucker to middle of testes zone : O. Gorakhpurensis Rai, 1971

Vitelline follicles extend from
little posterior of vesicula
seminalis to the posterior
testis

: O. bandai n.sp.

5. Pre-pharynx equal to
oesophagus, receptaculum
seminis smaller than ovary

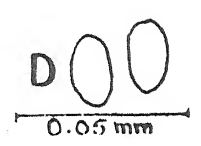
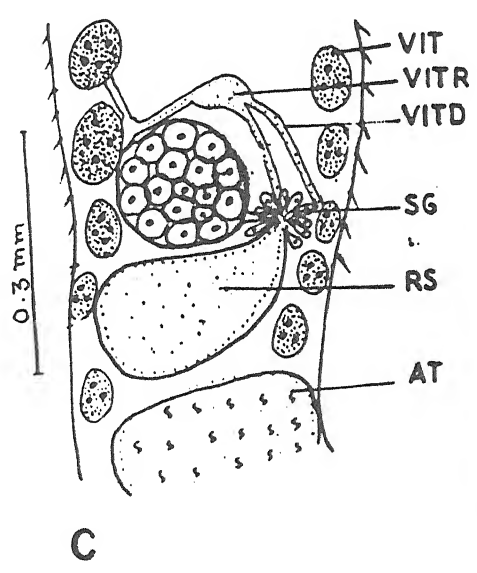
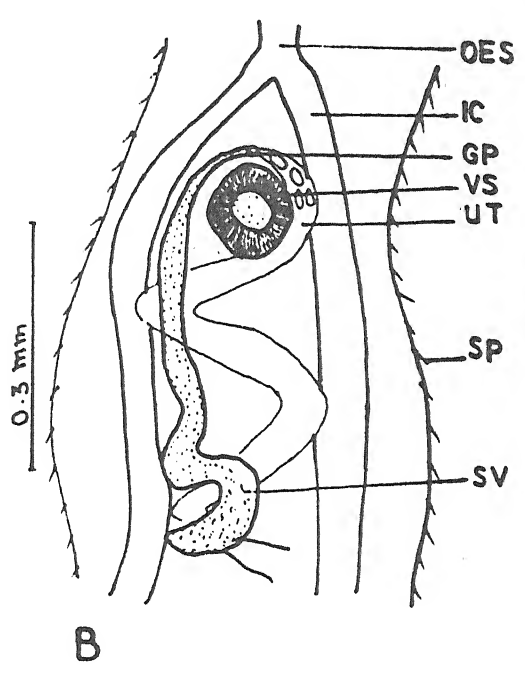
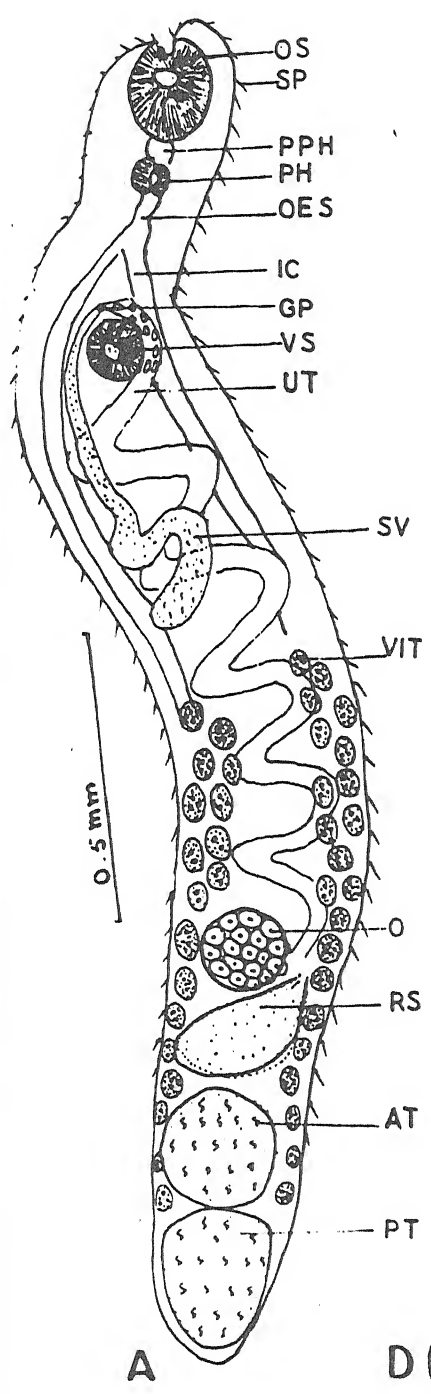
: O. gomtia (Thapar, 1930)
Mehra, 1941

Pre-pharynx larger to
oesophagus, receptaculum
seminis smaller than ovary

: O. gagatia (Dayal, 1949)
Rai, 1971

Figure
Opisthorchis bandai n.sp.

- A. Ventral view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Pseudoparamacroderoides yamunai n.sp.

(Fig. A, B, C, D)

Host	: <u>Mystus vittatus (Bl.)</u>
Locality	: Ken river, Panna, M.P.
No. of Fishes Examined	: 52
No. of Fishes Infected	: 2
Location	: Intestine
No. of Specimens Collected	: 4 + 4 = 8

DESCRIPTION

Body elongated, with blunt anterior and posterior ends. Cuticular spines extend up to the end of body. Oral sucker sub-terminal, rounded, with spines larger than the body spines. Ventral sucker pre-equatorial, rounded, more or less equal to oral sucker. Pre-pharynx prominent. Pharynx globular, muscular. Oesophagus short, tubular. Intestinal caeca extending up to little anterior to posterior end of body. Testes spherical, post-equatorial, obliquely tandem, more or less equal in size, separated from each other by uterus and excretory bladder. Cirrus sac claviform, extending from posterior end of ventral sucker up to front of ventral sucker, encloses

a pear-shaped vesicula seminalis, a tubular pars prostatica surrounded with prostate gland cells and a long, narrow ejaculatory duct. Ovary lobed, sub-median, post-acetabular. Receptaculum seminis saccular, post-ovarian. Uterus extends upto posterior end of body, opens at genital pore by a short metraterm. Shell glands numerous, surround the ootype. Laurer's canal present. Egg oval, operculated. Genital pore pre-acetublar, sub-median, on left side of intestinal bifurcation. Vitelline follicles extending from pharyngeal region to little anterior to intestinal caecal ends, two vitelline ducts unite to form a yolk reservoir which opens at ootype by a common vitelline duct. Excretory bladder tubular extends upto anterior testis, excretory pore terminal.

Body length, 1.16 - 2.24; width, 0.47 - 0.63; oral sucker, 0.16-0.19 x 0.16 - 0.23; ventral sucker, 0.17 - 0.20 x 0.16 - 0.20; pre-pharynx, 0.04 - 0.06 x 0.05 - 0.08; pharynx, 0.10 - 0.12 x 0.07 - 0.10; oesophagus, 0.18 - 0.23 x 0.03 - 0.06; anterior testis, 0.08 - 0.16 x 0.06 - 0.15; posterior testis, 0.08 - 0.16 x 0.06 - 0.15; cirrus sac, 0.22 - 0.27 x 0.04 - 0.08; vesicula seminalis, 0.05 - 0.08 x 0.03

- 0.05; pars prostatica, 0.04 - 0.05 x 0.04 - 0.06; ejaculatory duct, 0.09 - 0.13 x 0.01 - 0.02; ovary, 0.10 - 0.14 x 0.12 - 0.14; egg, 0.027 - 0.030 x 0.010 - 0.015. (All measurements were taken in mm.)

DISCUSSION

As evident from the literature, so far, only 4 species are known under the sub-genus Pseudoparamacroderoides Gupta and Agrawal, 1968 viz. P. seenghalai Gupta and Agrawal, 1968 from Mystus seenghala, P. vittatusi Kakaji, 1969 from Mystus vittatus; P. raychaudhurii Kumar, 1979 from Mystus vittatus and P. thapliwali Agrawal, 1980 from Mystus vittatus.

The present form chiefly differs from the other known species in the extension of vitelline follicles and the oesophagus is comparatively very short. It further differs from P. seenghalai in having a pre-pharynx, from P. vittatusi and P. thapliwali in the ratio of suckers and from P. raychaudhurii in the extension of cuticular spines, in having lobed ovary and in the position of genital pore.

The new species is named after the locality of the host.

Key to the Species of the sub-genus Pseudoparamacroderoides

Gupta and Agrawal, 1968.

1. Vitelline follicles from pharyngeal region to little anterior to intestinal caecal ends : P. yamunai n.sp.

Vitelline follicles from anterior end of ventral sucker or little anterior to ventral sucker to little short of intestinal caecal ends : 2

Vitelline follicles from middle or posterior end of ventral sucker to little short of intestinal caecal ends : 3

2. Oral sucker more or less equal to ventral sucker, excretory bladder in between testes and reaching upto middle of posterior testis : P. raychaudhurii
Kumar, 1979

Oral sucker larger than ventral sucker, excretory bladder reaching upto middle of posterior testis : P. vittatusi Kakaji, 1969

3. Pre-pharynx present, oral
sucker smaller than ventral
sucker

: P. thapliyal
Agrawal, 1980

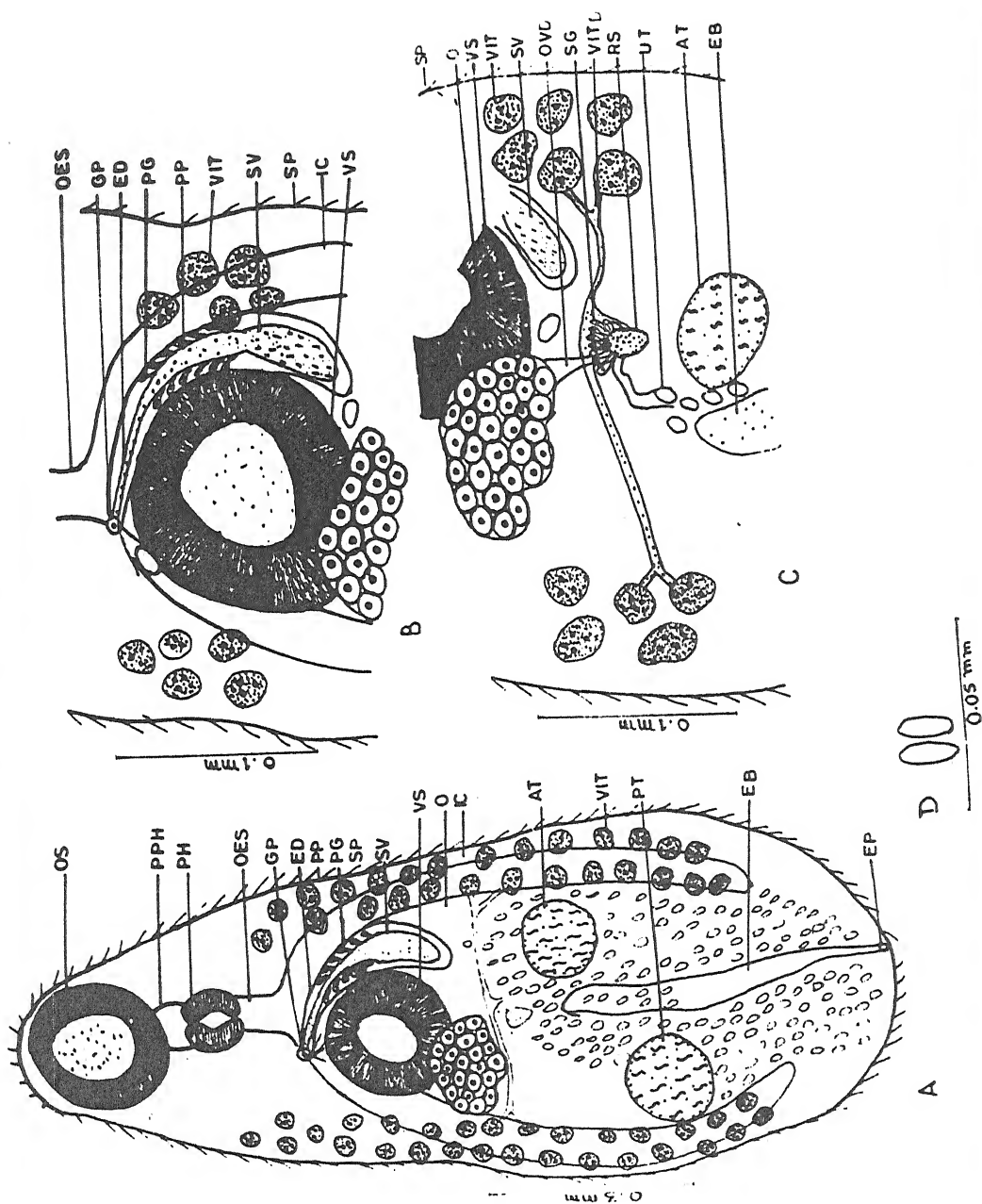
Pre-pharynx absent, oral
sucker equal to ventral sucker :

P. seenghalai
Gupta and Agrawal, 1968

Figure

Pseudoparamacroderoides yamunai n.sp.

- A. Dorsal view
- B. Cirrus sac enlarged (Drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Oudhia betwai n.sp.

(Fig. A, B, C, D)

Host	:	<u>Rita rita (Ham.)</u>
Locality	:	Fish market, Jhansi, Betwa river, Hamirpur, U.P.
No. of Fishes Examined	:	35
No. of Fishes Infected	:	2
Location	:	Intestine
No. of Specimens Collected	:	3 + 1 = 4

DESCRIPTION

Body elongated, spinose, spines present upto the limit of posterior testis, with rounded anterior and posterior ends. Oral sucker terminal, funnel shaped. Ventral sucker pre-equatorial, circular, more or less equal to oral sucker. Pre-pharynx moderate. Pharynx oval, muscular. Oesophagus long, tubular. Intestinal caeca extending upto middle of posterior testis. Testes rounded, tandem in middle region of body, equal. Cirrus sac extending from middle of ventral sucker up to the middle of oral sucker, long, curved, encloses a bipartite vesicula seminalis, an oval pars prostatica surrounded with prostate

gland cells and a long, narrow ejaculatory duct. Ovary oval, submedian, just-preequatorial, located in the left side of anterior testis. Receptaculum seminis small, oval post-opvarian. Uterus occupies entire posterior body, continues as metraterm to open at genital pore. Shell glands surround the ootype. Laurer's canal present. Egg oval, operculated. Genital pore located in the right side of oral sucker. Vitelline follicles restricted from the level of ventral sucker up to the anterior level of posterior testis, 5 on each side, two vitelline ducts unite to open at ootype. Excretory bladder Y-shaped, excretory pore situated on dorsal side at posterior end of body.

Body length 1.205 - 1.411; width, 0.41 - 0.54; oral sucker, 0.15 - 0.19 x 0.12 - 0.15; ventral sucker, 0.17 - 0.19 x 0.13 - 0.15; pre-pharynx, 0.03 - 0.05 x 0.02 - 0.03; pharynx, 0.05 - 0.08 x 0.03 - 0.04; oesophagus, 0.07 - 0.09 x 0.03 - 0.04; anterior testis, 0.17 - 0.19 x 0.13 - 0.15; posterior testis, 0.17 - 0.19 x 0.13 - 0.15; cirrus sac, 0.39 - 0.52 x 0.03 - 0.05; vesicula seminalis, 0.10 - 0.13 x 0.03 - 0.05; pars prostatica, 0.04 - 0.08 x 0.11 - 0.13; ejaculatory duct, 0.07 - 0.10 x 0.02 - 0.03; receptaculum seminis, 0.05 x 0.03; egg,

0.02 - 0.03 x 0.02 - 0.03 (All measurements were taken in mm.)

DISCUSSION

So far, only 2 species of the genus Oudhia Gupta, 1955, viz. O. horai Gupta, 1955 from the intestine or Heteropneutes fossilis and O. hardayali Kumar and Agarwal, 1980 from the intestine of Mystus vittatus, are known.

The present form differs from O. horai and O. hardayali in the ratio of suckers, extension of vitelline follicles, position of gonads and genital pore and also in the extension of cuticular spines.

The name of new species is given in the honour of Prof. M. S. Kanungo, a reputed Zoologist and present Head of the Department of Zoology, Banaras Hindu University.

Key to the Species of the genus Oudhia Gupta, 1955.

1. Oesophagus short : 2

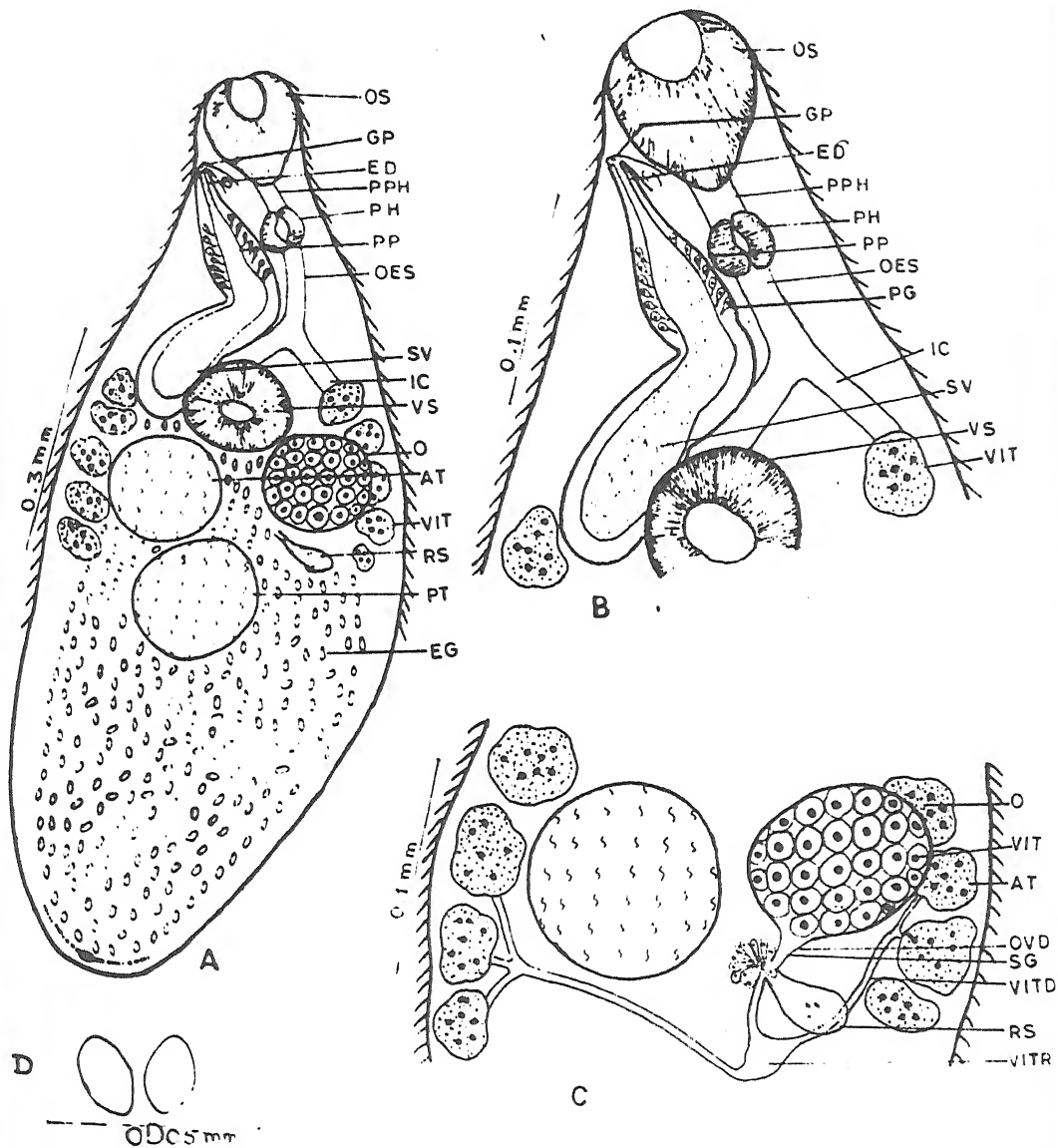
Oesophagus long : 3
2. Testes lie obliquely, genital pore at pre-pharynx zone : O. horai Gupta, 1955
3. Testes tandem, genital pore at pore at pharyngeal zone : O. hardayali
Kumar and Agrawal, 1980

Testes tandem, genital pore at the middle level of oral sucker : O. betawai n.sp.

Figure

Oudhia betwai n.sp.

- A. Ventral view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Neopodocotyle chandrai n.sp.

(Fig. A, B, C, D)

Host	:	<u>Heteropneustes fossils</u> (Bl.)
Locality	:	Fish Market, Hamirpur, U.P.
No. of Fishes Examined	:	20
No. of Fishes Infected	:	4
Location	:	Intestine
No. of Specimens Collected	:	2 + 4 + 3 + 2 = 11

DESCRIPTION

Body smooth, elongated, with blunt anterior and posterior ends. Oral sucker sub-terminal circular. Ventral sucker pre-equatorial, sub-spherical, smaller than oral sucker. Pre-pharynx absent. Pharynx globular, muscular. Oesophagus, short. Intestinal caeca reaching upto posterior end of the body. Tests oval or sub-spherical, tandem, post-equatorial, more or less equal in size. Cirrus sac located anteriorly to ventral sucker, later half covered by left intestinal caecum, slightly curved, encloses a saccular vesicula seminalis, a short pars prostatica surrounded with numerous prostate gland cells and a long narrow ejaculatory duct. Ovary oval, pre-equatorial on

and a long narrow ejaculatory duct. Ovary oval, pre-equatorial on right latero-posterior position of ventral sucker. Receptaculum seminis oval or pear shaped situated a little posterior to ovary. Uterus limited extends not beyond the level of anterior testis, finally opening through a metraterm at genital pore. Shell glands numerous, surround the ootype. Laurer's canal not visible. Egg oval, yellow, operculated. Genital pore extracaecal on left side. Vitelline follicles on two lateral sides, extend from posterior end of ventral sucker up to a little anterior to hind end of body. Two vitelline ducts unite to form a yolk reservoir which opens at ootype through a common vitelline duct. Excretory bladder tubular, enlogated, excretory pore at hind end of body.

Body lengthm 1.97 - 2.53; width 0.45 - 0.61; oral sucker, 0.26-0.27 x 0.24 - 0.27; ventrai sucker, 0.16 - 0.21 x 0.16 - 0.21; pharynx 0.06 - 0.10 x 0.08; oesophagus, 0.09 - 0.10 x 0.05 - 0.06; anterior testis, 0.17 - 0.20 x 0.16 - 0.24; posterior testis, 0.17 - 0.20 x 0.21 - 0.26; cirrus sac, 0.20 - 0.24 x 0.06 - 0.09; ovary, 0.10 - 0.15 x 0.09 - 0.13; receptaculum seminis, 0.13 x 0.09 - 0.16; egg, 0.05 - 0.06 x 0.10 - 0.13. (All measurement were taken in mm.)

DISCUSSION

The genus Neopodocotyle was established by Dayal (1944), in a note, with N. indica as type species from the intestine of Callichorous bimaculatus. In 1950, he published the detailed account of this species. Yamaguti (1958), regarded Neopodocotyle as a sub-genus of podocotyle (Dujardin, 1845) Odhner, 1905 and placed it under the sub-family Allocreadinae Looss, 1902 of the family Allocreadidae (Looss, 1902) Stossich, 1903 but Mehra, 1966 considered Neopodocotyle as a genus and placed it under sub-family Plagioporinae Manter, 1947 of the family Opecoeliadae Ozaki, 1925, Orutcgard (1966) reviewed the species of Podocotyle and rearranged them in five genera. Yamaguti (1971) included under the genus Podocotyle, five sub-genera viz. Podocotyle (Dujardin, 1845) Odhner, 1905; Neopodocotyle (Dayal, 1944); Apopodocotyle (Pritchard, 1966); Neopodocotyloides (Pritchard, 1966) and Pedunculotrema (Fishchthal and Thomas, 1970). Rai (1971) and Pandey (1975) also supported Pritchard's view and considered Neopodocotyle as a genus. Perhaps the later author was not aware of the view of Yamaguti (1971).

Since the position of uterus in between ovary and anterior testis appears to be a character of sub-generic importance, therefore, the writer agrees with Yamaguti (1971) and regard Neopodocotyle as a sub-genus of Podocotyle.

So far 8 species of the sub-genus Neopodocotyle are known viz. N. indicia Dayal, 1944 from Callichrous bimaculatus; N. spinipora Sircar and Sinha, 1969 from Rita rita; N. mehrai Rai, 1971 from Barbus sarana and B. sophore; N. balliaensis Pandey, 1975 from Labeo calbasu; N. dayali Pandey, 1975 from Barbus sarana; N. gorakhpurensis Agarwal and Kumar, 1978 from Amphipnous cuchia, N. chauhani Agrawal, 1980 from Puntius sarana and N. matatilaensis Agrawal, 1980 from Puntius sophore.

The present form chiefly differs from all the above stated species in having oral sucker larger than the ventral sucker and in the position of ovary and genital pore. It further differs from N. indica, N. mehrai, N. balliaensis, N. gorakhpurensis, N. chauhani and N. matatilaensis in the position of cirrus sac. It also differs from N.

spinopora in not having circlet of spines at genital pore and from N. dayali in the ratio of testes.

Therefore, on the basis of oral sucker larger than ventral sucker, para-cetabular ovary, position of cirrus sac and extra caecal genital pore, the present species is considered as a new species.

The name of the new species is given after the locality of the host.

Key to the Species of the sub-genus Neopodocotyle Dayal, 1944.

1. Oral sucker equal to ventral sucker : 2

 Oral sucker smaller than ventral sucker : 3

 Oral sucker larger than ventral sucker : N. chandrai n.sp.
2. Cirrus sac extending upto pharynx, genital pore on left side of pharynx : N. indicia Dayal, 1944

 Cirrus sac extending upto oesophagus, genital pore on right side of oesophagus : N. balliaensis Pandey, 1975
3. Vitelline follicles extending from mid region of ventral sucker to hind end of body : 4

 Vitelline follicle extending from posterior margin of ventral sucker to hind end of body : 5
4. Genital pore on left side of

4. Genital pore on left side of oesophagus, with circlet of spines : N. spinopora
Sircar and Sinha, 1969

Genital pore in between oesophageal bifurcation and anterior end of ventral sucker, without circlet of spines : N. mehrai Rai, 1971

5. Genital pore at the level of intestinal bifurcation or at the intestinal bifurcation : 6

Genital pore at the mid level of oesophageal region on the right lateral side of body : N. matatilaensis
Agrawal, 1980

6. Pre-pharynx present : N. gorakhpurensis
Agarwal & Kumar, 1978

Pre-pharynx absent : 7

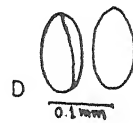
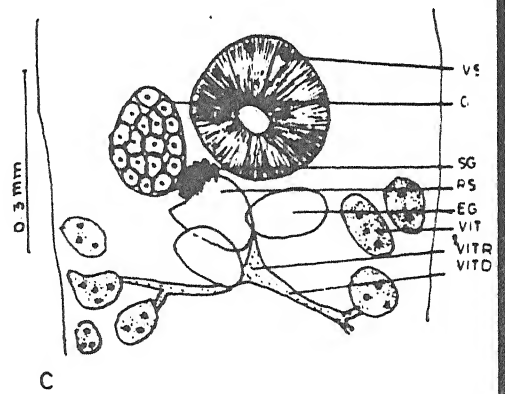
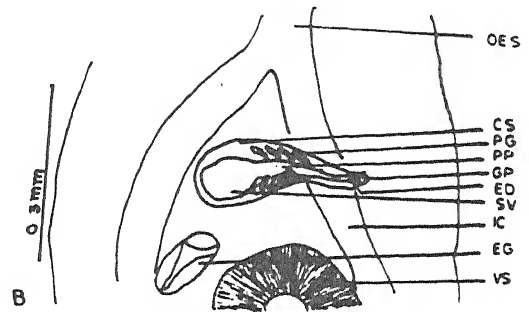
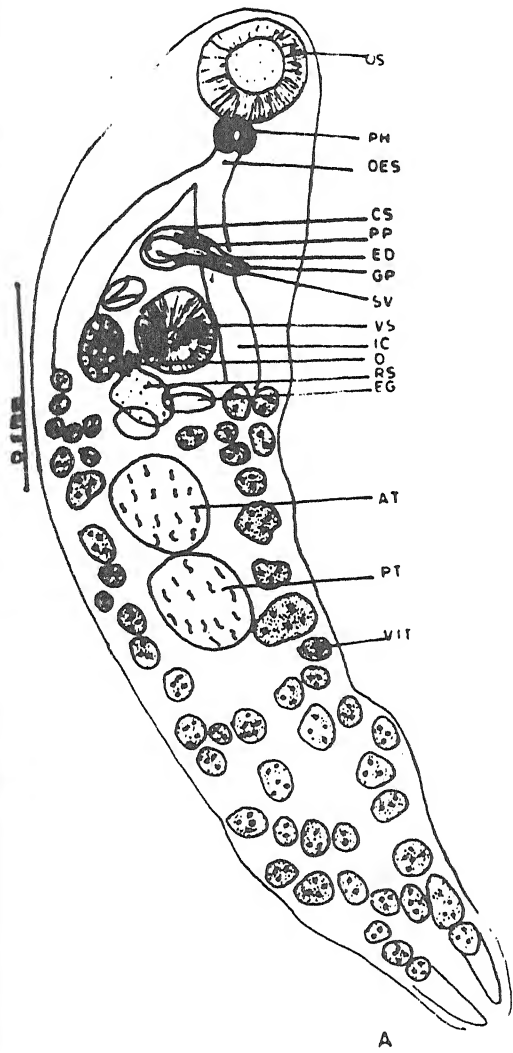
7. Oesophagus long : N. chauhani
Agrawal, 1980

Oesophagus short : N. dayali Pandey, 1975

Figure

Neopodocotyle chandrai n.sp.

- A. Dorsal view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Dactylostomum hamirpurensis n.sp.

(Fig. A, B, C, D)

Host	:	<u>clupisoma gorua</u> (Bl.)
Locality	:	Hamirpur, U.P.
No. of Fishes Examined	:	90
No. of Fishes Infected	:	2
Location	:	Intestine
No. of Specimens Collected	:	2 + 2 = 4

DESCRIPTION

Body elongated, smooth, tapering anteriorly and rounded at posterior end. Oral sucker terminal, oval. Ventral sucker large, muscular, pedunculated with two dactyles. Pre-pharynx present. Pharynx rounded, muscular. Oesophagus long, tubular. Intestinal caeca fused posteriorly to form cyclocoel. Testes oval, tandem, post-equatorial, anterior testis smaller than posterior testis. Cirrus lacking. Vesicula seminalis lies freely in parenchyma, close to ventral sucker. Ovary rounded or oval, pre-testicular, equatorial. Receptaculum seminis rounded. Uterus intercaecal, limited between ootype to genital pore, opens through a metraterm at genital pore.

Egg oval, operculated, yellow. Genital pore near the intestinal bifurcation. Vitelline follicles extend from the level of ventral sucker to posterior end of the body, extensive in the posterior region. Excretory bladder long, tubular, excretory pore terminal.

MEASUREMENTS

(All measurements were taken in mm.)

Body length, 2.60-3.91; width, 0.54 - 0.39; oral sucker, 0.17 - 0.21 x 0.18 - 0.20; ventral sucker, 0.28 - 0.39 x 0.30 - 0.41; dactyles, 0.08 - 0.10 x 0.04 - 0.05; pre-pharynx, 0.06 - 0.12 x 0.03 - 0.04; pharynx, 0.04 - 0.09 x 0.03 - 0.05; oesophagus, 0.09 - 0.20 x 0.02 - 0.05; anterior testis, 0.28 - 0.43 x 0.30 - 0.38; posterior testis, 0.39 - 0.52 x 0.34 - 0.42; ovary, 0.17 - 0.23 x 0.15 - 0.18; receptaculum seminis, 0.13 - 0.15 x 0.19 - 0.20; egg, 0.04 - 0.06 x 0.03 - 0.04.

DISCUSSION

The genus Dactylostomum was established by Woolcock in 1935 with the type species D. gracile from a marine fish Myxus elongatus from Australia. Subsequently, five more species were

added to this genus viz. D. vitellosum Manter, 1940 from an unidentified marine fish from Columbia; D. caballeroi Martin, 1960 from a marine fish Pseudupeneus fraterculus from Hawaii; D. winteri Caballero and Caballero, 1971 from a marine fish Paralabrax maculotafasciatus from Mexico; D. harishii Agrawal and Agarwal, 1978 and D. jhansiensis Agrawal, 1980 from a fresh water fish Mastacembelus armatus from Jhansi (India).

The new species mainly differs from all other species in the number of dactyles on the ventral sucker and in the position of genital pore except D. jhansiensis. It further differs from D. gracile, in the extension of vitelline follicles, in having short oesophagus except in D. jhansiensis and also differs from D. caballeroi and D. winteri in having the stalked ventral sucker.

The new species is named after the name of the host.

Key to the Species of the genus Dactylostomum Woolcock, 1935.

1. Ventral sucker sessile : 2

Ventral sucker stalked : 3
2. With 4 clusters of 4 dactyles and 4 isolated dactyles : D. caballeroi, Martin, 1960

With 3 small dactyles : D. winteri Caballero & Caballero, 1971
3. With 2 small dactyles : D. hamirpurensis n.sp.

With 4 dactyles : D. harishii Agrawal & Agrawal, 1978

With 3 large, round, median lobes, 6 papilla-like elevations 3 on each side : D. vitellosum Manter, 1940

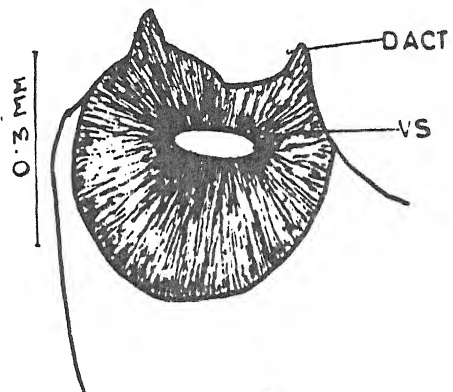
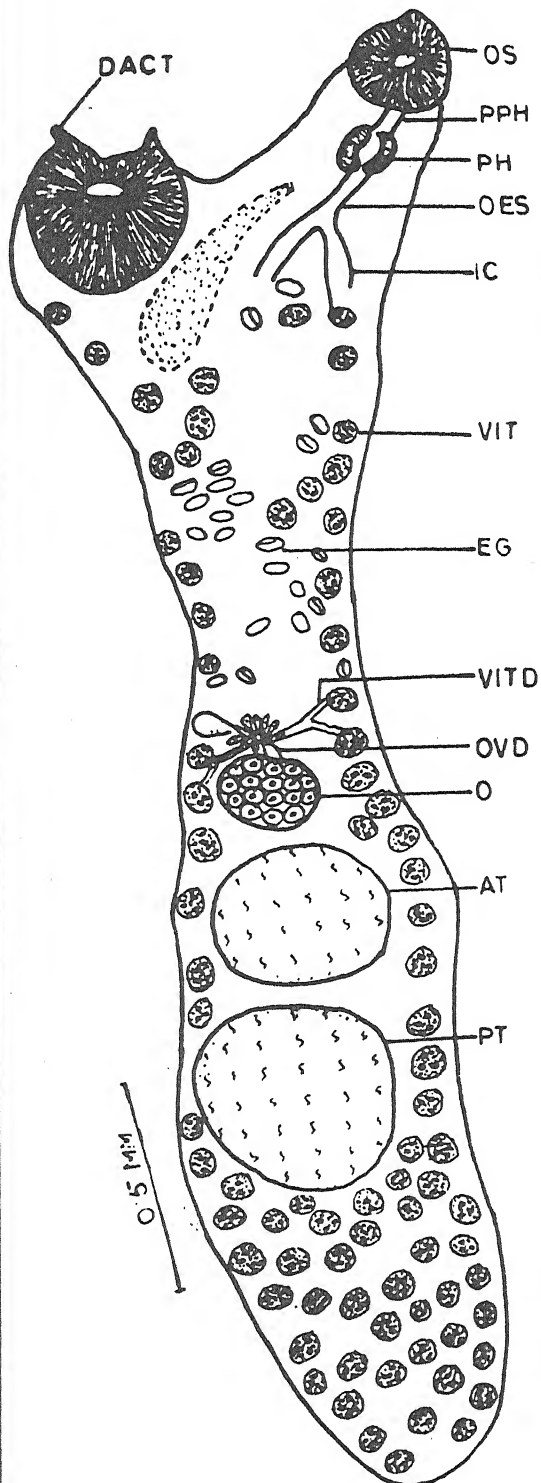
With 6 dactyles : 4
4. Oesophagus small, vitelline follicles extend from a distance below the level of intestinal bifurcation upto posterior end of body : D. gracile Woolcock, 1935

Oesophagus moderately long, vitelline follicles extend from the level of intestinal bifurcation upto posterior end of body : D. jhansiensis Agrawal, 1980

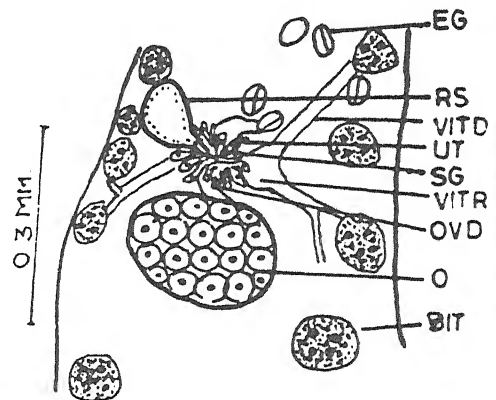
Figure

Dactylostomum hamirpurensis n.sp.

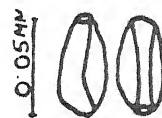
- A. Ventral view
- B. Ventral sucker enlarged showing dactyles (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



B



C



Bundelatrema kalpiensis n.sp.

(Fig. A, B, C, D)

Host	: <u>Mystus oar</u>
Locality	: River Yamna, Kalpi
No. of Fishes Examined	: 85
No. of Fishes Infected	: 2
Location	: Liver
No. of Specimens Collected	: 2 + 2 = 4

DESCRIPTION

Body large, with rounded anterior and posterior ends. Oral sucker sub-terminal, oval or rounded, smaller than ventral sucker. Ventral sucker pre-equatorial, large, rounded. Pre-pharynx small. Pharynx oval, muscular. Oesophagus very short. Intestinal caeca terminating at posterior extremity. Testes spherical, post-equatorial, diagonal, anterior testis smaller than posterior one. Cirrus sac elongated, just above the ventral sucker; enclosing a pear-shaped vesicula seminalis, pars prostatica surrounded by prostate gland cells and a curved ejaculatory duct. Ovary oval or rounded, sub-median, post-equatorial. Receptaculum seminis oval, sub-median

median, post-equatorial. Receptaculum seminis oval, sub-median located in the right side of ovary. Uterus fills two-third of body, prominently coiled intercaecally inbetween ovary and ventral sucker, containing numerous embryonated eggs and finally opens through a metraterm at genital pore. Shell glands numerous, surrounding the ootype. Eggs oval, operculated, embryonated. Genital pore pre-acetabular. Vitelline follicles, thin, scattered from the anterior to posterior extremity of the body. Excretory bladder tubular, bifurcating behind posterior testis, excretory pore sub-terminal at posterior end of body.

Body length, 4.11 - 7.75; width, 1.50 - 2.63; oral sucker, 0.47 - 0.58 x 0.47 - 0.60; ventral sucker, 0.65 - 0.93 x 0.60 - 0.92; pre-pharynx, 0.01 - 0.04 x 0.02 - 0.04; pharynx, 0.13 - 0.18 x 0.10 - 0.17; oesophagus, 0.08 - 0.13 x 0.04 - 0.06; anterior testis, 0.27 - 0.40 x 0.24 - 0.38; posterior testis, 0.34 x 0.48 x 0.34 - 0.39; cirrus sac, 0.23 - 0.54 x 0.09 - 0.23; vesicula seminalis, 0.08 - 0.23 x 0.12 - 0.14; pars prostatica, 0.10 - 0.14 x 0.13 - 0.15; ejaculatory duct, 0.12 - 0.13 x 0.05 - 0.08; ovary, 0.27 - 0.48 x 0.26 - 0.49;

0.04 - 0.06. (All measurements were taken in mm.)

DISCUSSION

Genus Bundelatrema was suggested by Agrawal (1980) with the type species B. betwai and was placed in the sub-family Azygiinae Luhe, 1909 of the family Azygiidae Odhner, 1911. The new genus was established by distinguishing it from the genus Azygia Looss (1899) in having excretory arms not united anteriorly and from the genus Otodistomum Stafford, 1904 in having no genital cone or papilla in genital atrium.

The present form chiefly differs from the other known species in having a short pre-pharynx, ratio of testes, in the extension of vitelline follicles and uterus also occupying the anterior part of the body.

It is therefore, regarded as a new species for which the name B. kalpiensis is proposed after the locality of the host.

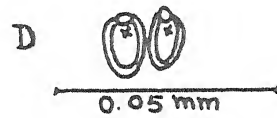
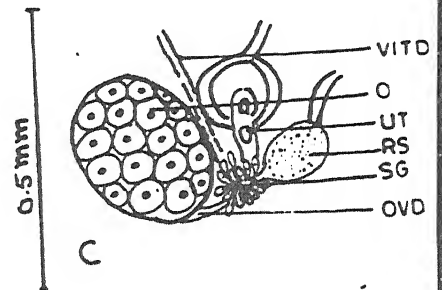
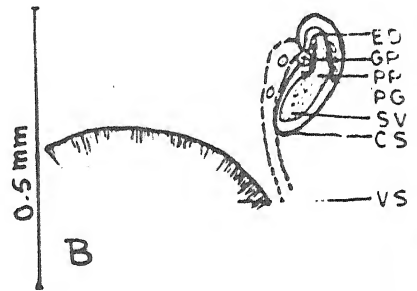
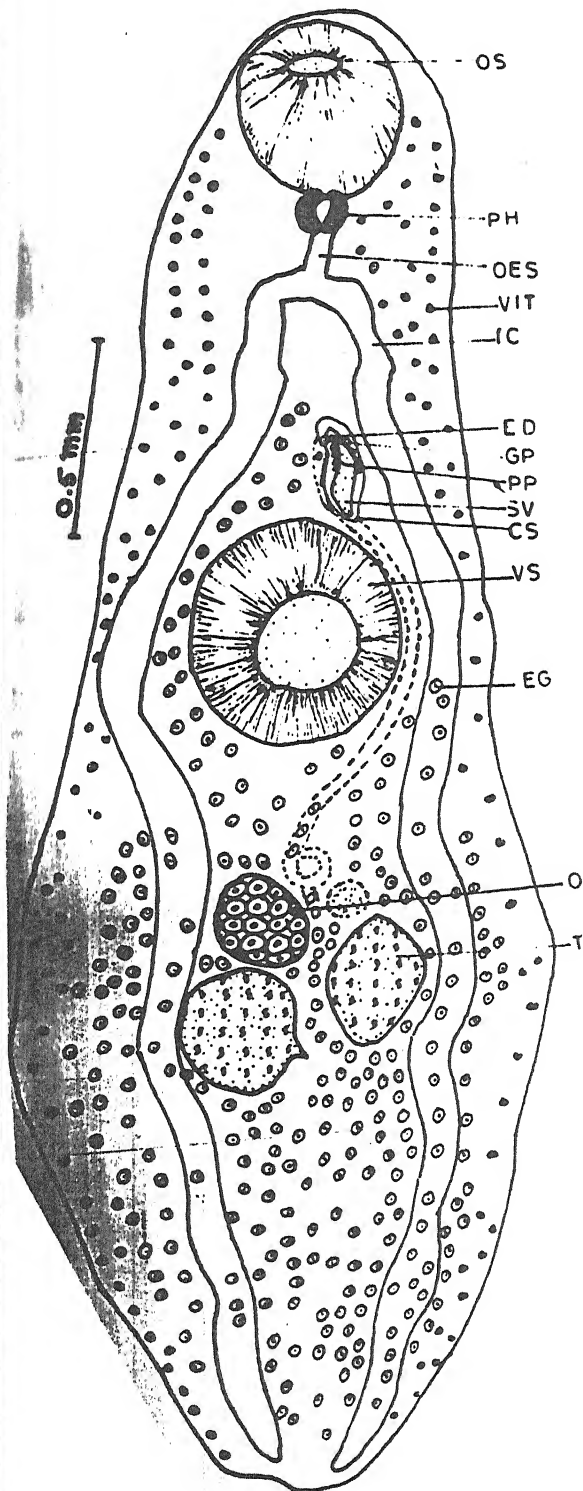
Key to the Species of the genus Bundelatrema Agrawal, 1980.

1. Vitelline follicles present from anterior end of body upto the level of ovary, uterus confined to posterior half region of body testes more or less equal : B. betwai Agrawal, 1980
2. Vitelline follicles present from anterior end of body upto posterior end of body uterus also extends into the anterior portion testis smaller than posterior testis : B. kalpiensis n.sp.

Figure

Bundelatrema kalpiensis n.sp.

- A. Dorsal view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Faustula anuragiensis n.sp.

(Fig. A, B, C, D)

Host	: <u>Mystus tengara</u>
Locality	: Fish Market, Hamirpur
No. of Fishes Examined	: 42
No. of Fishes Infected	: 3
Location	: Intestine
No. of Specimens Collected	: 3 + 3 + 4 = 10

DESCRIPTION

Body elongated, smooth, with blunt anterior and posterior ends. Oral sucker sub-terminal, rounded. Ventral sucker equatorial, rounded, larger than the oral sucker. Pre-pharynx absent. Pharynx globular, muscular. Oesophagus short, bifurcating into two intestinal caeca. Caeca extending upto the posterior margin of testes. Testes oval, para-acetabular. Cirrus sac extends from anterior margin of ventral sucker to the middle of oesophagus, pyriform, encloses a coiled vesicula seminalis, a short pars prostatica surrounded with numerous prostate gland cells and a short ejaculatory duct. Ovary

post-testicular, seven lobed. Uterus arises from ootype, occupying whole of the post-testicular area of body. Metraterm short, opening at genital pore. Shell glands few, surround the ootype. Laurer's canal not seen. Egg oval, operculated. Genital pore median, at the middle of oesophagus. Vitelline follicles 6 - 7 on either sides extending from the level of intestinal bifurcation up to the posterior margin of testes, from each group of vitelline follicles arises a transverse duct uniting with its fellow to form common duct which opens at ootype. Excretory bladder V. shaped, excretory pore at the hind end of body.

Body length, 1.29 - 1.60; 0.45 - 0.53; oral sucker, 0.15 - 0.18 x 0.10 x 0.12; ventral sucker, 0.18 - 0.20 x 0.15 - 0.19; pharynx, 0.08 - 0.11 x 0.07 - 0.09; oesophagus, 0.12 x 0.14; left testis, 0.15 - 0.19 x 0.10 - 0.13; right testis, 0.17 - 0.20 x 0.13 - 0.16; cirrus sac, 0.39 - 0.42 x 0.13 - 0.18; ovary, 0.23 - 0.26 x 0.15 - 0.17; egg, 0.03 - 0.05 x 0.03 - 0.04. (All measurements were taken in mm.)

DISCUSSION

So far 12 species of the genus Faustula Poche, 1926 are known - viz. F. keksooni (MacCallum, 1918) Poche, 1926 from an

unspotted ray; F. savori (Yamaguti, 1942) Yamaguti, 1958 from Hyporhamphus savori; F. brevichrus (Srivastava, 1935) Yamaguti, 1958 from Hilsa ilisha; F. gapgeticus (Srivastava, 1935) Yamaguti, 1958 from Hilsa ilisha; F. ilishii (Srivastava, 1935) Yamaguti, 1958 from Hilsa ilisha; F. clupii (Srivastava, 1935) Yamaguti, 1958 from Hilsa ilisha; F. basiri Hafeezullah and Siddiqi, 1970, from Hilsa ilisha; F. gasterostei Schell, 1973 from Gasterosteus aculeatus; F. mandapamensis Simha, 1974 from Stromateus cinereus; F. varapasiensis Agarwal and Kumar, 1977 from Hilsa ilisha; F. pyriformis Kumar, 1979 from Hilas ilisha. Besides these F. makundi Agarwal and Verma, 1981 and F. indica Agarwal and Verma, 1981 from Clupea ilisha are reported recently. F. Chauhani Gupta and Srivastava, 1960 has been regarded as synonym of F. brevichrus by Simha (1974).

The present form comes closer to F. clupii in the extension of cirrus sac from anterior end of ventral sucker to oesophageal region and in the position of genital pore but differs from it in the extension of vitelline follicles and in having only seven lobed ovary.

The new species is named after the name of the host.

Key to the Species of the genus Faustula Poche, 1926.

1. Oral sucker larger than ventral sucker : 2

Oral sucker smaller than ventral sucker : 3
2. Cirrus sac extends from anterior end of ventral sucker up to a little anterior to intestinal bifurcation, ovary deeply lobed : F. basiri, Hafeezullah & Siddiqi 1970

Cirrus sac extends from posterior end of ventral sucker up to anterior end, ovary 4-lobed : F. makundi Agarwal & Verma, 1981
3. Oesophagus present : 4

Oesophagus absent : F. ilishii (Srivastava, 1935) Yamaguti, 1958
4. Genital pore above the level of intestinal bifurcation or at oesophageal region : 5

Genital pore at the level of intestinal bifurcation : F. brevichru (Srivastava, 1935) Yamaguti, 1958

4. Genital pore above the level of intestinal bifurcation or at oesophageal region : 5
- Genital pore at the level of intestinal bifurcation : F. brevichrus (Srivastava, 1935), Yamaguti, 1958
- Genital pore below the level of intestinal bifurcation : 6
5. Ovary 6-lobed, vitellaria extend from intestinal bifurcation up to hind end of testes : F. indica Agarwal & Verma, 1981
- Ovary 7-lobed, vitellaria extend from intestinal bifurcation up to posterior margin of testes : F. anuragiensis n.sp.
- Ovary 9 to 10-lobed, vitellaria extend from intestinal bifurcation up to anterior margin of testes : F. clupii (Srivastava, 1935) Yamaguti, 1958
6. Testes lobed : F. gasterostei Schell, 1973
- Testes entire : 7
7. Ovary entire : F. varapasiensis Agarwal & Kumar, 1977
- Ovary lobed : 8

8. Vitellaria extend from
oesophageal region upto
middle of ovary

: 9

Vitellaria extend from
posterior half of oesophagus
upto little posterior to ovary

: F. mandapamensis

Simha, 1974

Vitellaria extend from
intestinal bifurcation up to little
below the anterior margin of
testes

: F. pyriformes

Kumar, 1979

Vitellaria extend from post-
bifurcal to middle of ventral
sucuker

: F. keksooni

MacCallam, 1918

9. Ovary 5 - 6 lobed

: F. hilsai Kumar, 1979

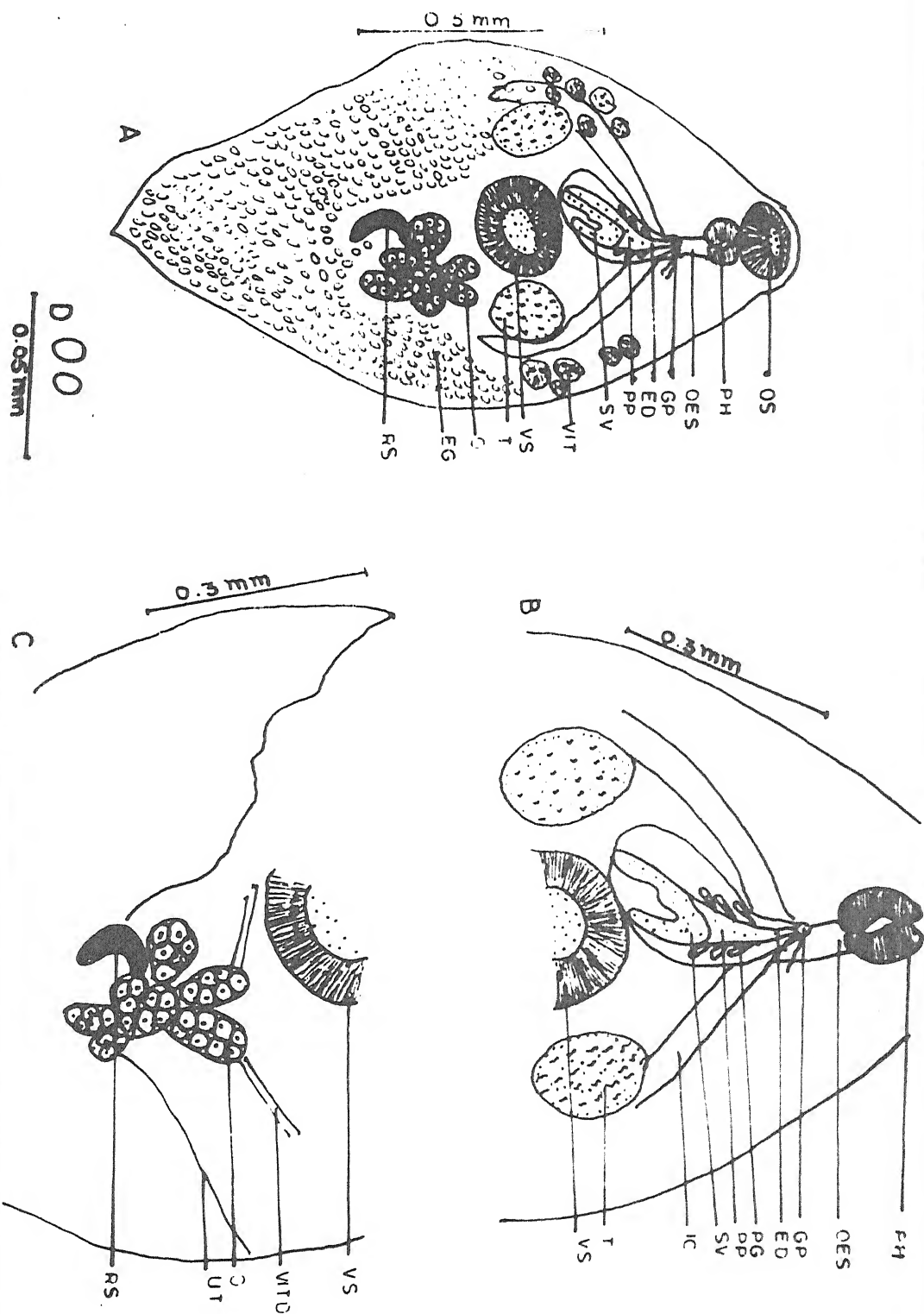
Ovary 8 - 9 lobed

: F. gangeticus (Srivastava
1935) Yamaguti, 1958

Figure

Faustula anuragiensis n.sp.

- A. Ventral view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Phyllodistomum vittatusi Gupta, 1953.

(Fig. A, B, C, D)

Host	: <u>Mystus cavasisus</u>
Locality	: Fish market, Rath, Hamirpur, U.P.
No. of Fishes Examined	: 84
No. of Fishes Infected	: 2
Location	: Intestine
No. of Specimens Collected	: 1 + 1 = 2

DESCRIPTION

Body smooth, with narrow anterior and expanded posterior ends. Oral sucker oval, sub-terminal, larger than ventral sucker. Ventral sucker rounded, situated in anterior third of body. Pre-pharynx absent. Pharynx absent. Oesophagus short. Intestinal caeca broad, terminate a little in front of the hind end. Testes larger than ovary, irregular, intercaecal, tandem obliquely one behind the other. Cirrus sac absent. Vesicula seminalis free in parenchyma, opens into a small vesicular pouch into which uterus also opens. Ovary oval, situated on the left side of the vitelline gland. The uterus arises from the posterior side of ootype between the vitelline ducts, runs

backward, fills up nearly all the space of the body, posterior to vitelline gland, forming numerous coils, anteriorly runs dorsal to the ventral sucker to open into the small circular genital pouch which opens outside at the genital pore. Egg oval, with a thin light brown shell. Genital pore lies between intestinal bifurcation and the ventral sucker. The vitelline gland consists of two lobed follicles lying at some distance behind the acetabulum, symmetrically one on either side of the ootype, intercaecal in position. Excretory bladder tubular, excretory pore terminal.

Body length, 4.81 - 5.52; width, 3.15 - 3.69; oral sucker, 0.46 - 0.49 x 0.26 - 0.29; ventral sucker, 0.31 - 0.34 x 0.30 - 0.32; oesophagus, 0.40 - 0.45 x 0.08 - 0.10; vesicula seminalis, 0.21 - 0.24 x 0.05 - 0.06; ovary, 0.42 - 0.45 x 0.31 - 0.35; egg, 0.018 - 0.019 x 0.011 - 0.012 (All measurements were taken in mm.)

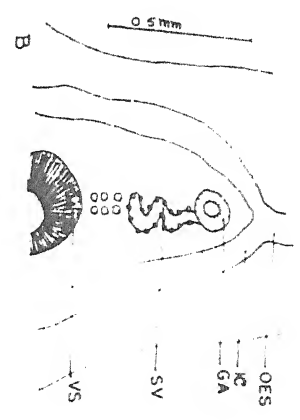
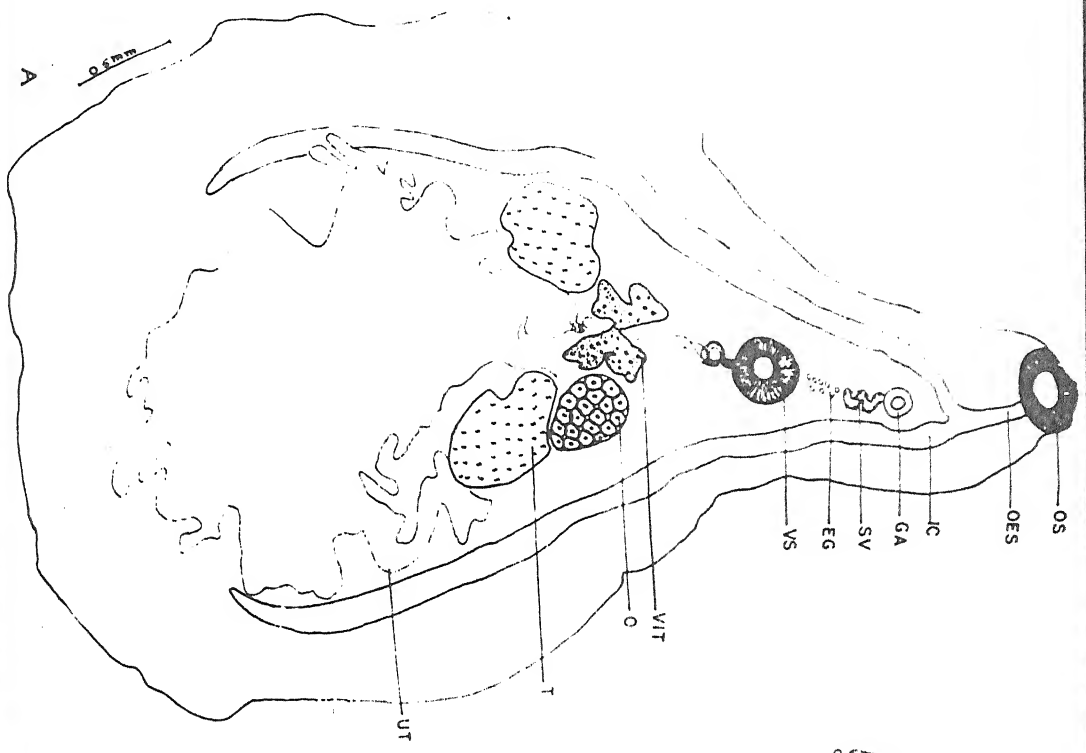
DISCUSSION

The present form belongs to Phyllodistomum vittatusi Gupta, 1953 but slightly differs in the size of oesophagus and testes being larger than ovary. These are considered as individual variable features. This is also being recorded from Rath, Hamirpur.

Figure

Phyllodistomum vittatusi Gupta 1953

- A. Dorsal view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Orientocreadium batrachoides Tubangui, 1931

(Fig. A, B, C, D)

Host	: <u>Wallago bleekeri</u> (Linn.)
Locality	: River, Yamuna, Hamirpur, U.P.
No. of Fishes Examined	: 43
No. of Fishes Infected	: 3
No. of Specimens Collected	: 3 + 3 + 4 = 10

DESCRIPTION

Body elongated, smooth or spinose, with rounded anterior and blunt posterior ends. Oral sucker sub-terminal, spherical. Ventral sucker pre-equatorial, rounded, more or less equal to oral sucker. Pre-pharynx prominent. Pharynx oval, muscular. Oesophagus very short. Intestinal caeca reaching up to hind end of the body. Testes oval or rounded, post-equatorial, more or less equal in size. Cirrus sac lies on right side of ventral sucker, extending from anterior margin of ovary up to front of ventral sucker, elongated, encloses a saccular vesicula seminalis interna followed by a pars prostatica surrounded with numerous prostate gland cells and a long

ejaculatory duct. A vesicula seminalis externa extends up to anterior margin of ovary. Ovary oval, equatorial. Uterus extends in whole hind body, opens at genital pore by metraterm. Shell glands few in number, surround the ootype. Laurer's canal present. Egg oval, yellow, operculated. Genital pore sub-median, pre-acetabular. Vitelline follicles extend from the anterior margin of ovary up to hind end of body, two vitelline ducts unite to form a yolk reservoir to opens at ootype by a common vitelline duct. Excretory bladder tubular, excretory pore lies at posterior end.

Body length, 1.95 - 2.42; width, 0.45 - 0.49; oral sucker, 0.19 - 0.23 x 0.18 - 0.22; ventral sucker, 0.19 - 0.23 x 0.18 - 0.23; pre-pharynx, 0.04 - 0.06 x 0.07 - 0.08; pharynx, 0.09 - 0.12 x 0.07 - 0.10; oesophagus, 0.07 - 0.08 x 0.06 - 0.07; anterior testis, 0.19 - 0.22; cirrus sac, 0.40 - 0.42 x 0.06 - 0.08; vesicula seminalis interna, 0.08 - 0.15 x 0.05 - 0.07; vesicula seminalis externa, 0.10 - 0.13 x 0.33 - 0.35; ovary, 0.12 - 0.16 x 0.11 - 0.14; egg, 0.027 - 0.033 x 0.013 - 0.018. (All measurements were taken in mm.)

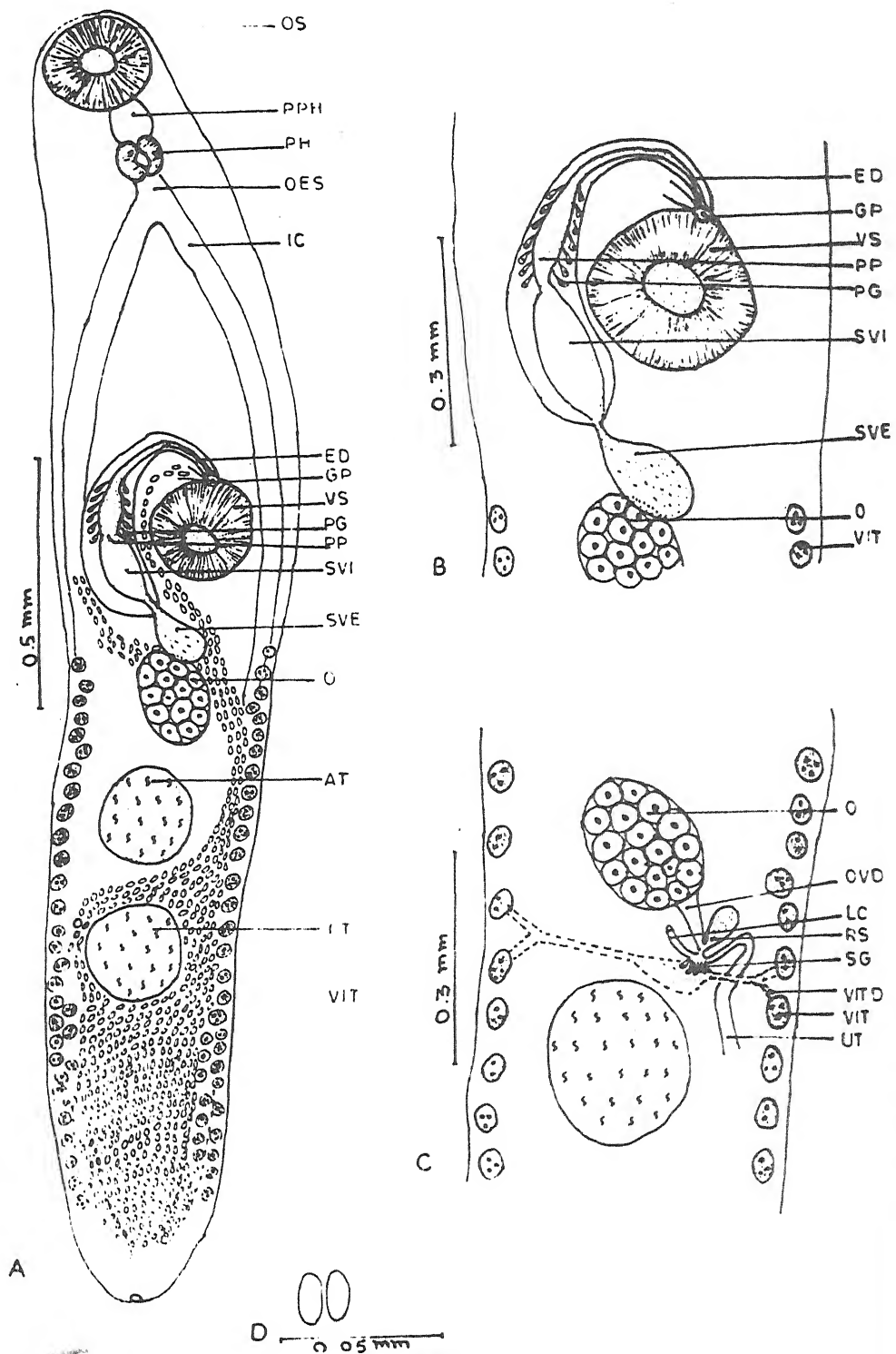
DISCUSSION

The present form belongs to **Orientocreadium batrachoides**, 1931. Earlier workers viz. Beverly - Burton (1962), Fischthal and Kuntz (1963), Agrawal (1963) and Pandey (1971) have also recorded this species from different fishes. This is first record of **Orientocreadium batrachoides**, from Hamirpur, Uttar Pradesh.

Figure

Orientocreadium batrachoides Tubangui 1931

- A. Ventral view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Genarchopsis singularis Srivastava (1933)

Host	: <u>Mystus bleekeri</u>
Locality	: Pond at Rohta (Jalaun)
No. of Fishes Collected	: 180
No. of Fishes Infected	: 4
Location	: Intestine
No. of Specimens Collected	: 1 + 2 + 2 + 1 = 6

DESCRIPTION

Body small oval, 0.98 - 3.32 x 0.49 - 0.86 with maximum breadth at acetabula zone. Oral sucker oval, subterminal, 0.13-0.33 x 0.19 - 0.37. Pharynx oval; 0.08 - 0.2 x 0.07 - 0.10. Oesophagus small.

Testes symmetrical, postacetabular, oval, overlapping intestinal caeca, measuring 0.11 - 0.21 x 0.09 - 0.09 - 0.13 and 0.11 - 0.20 x 0.08 - 0.17 respectively. Cirrus sac absent.

Ovary small, spherical, median, post-testicular, lying in the hind part of body, anterior to vitelline follicles, 0.067 - 0.22 x 0.087 - 0.16. Shellgland complex postovarian. Uterus with transverse coils

extending posteriorly upto vitelline zone which continues anteriorly as matraterm and opens into pars prostatica. Eggs yellowish oval, $0.021 - 0.037 \times 0.011 - 0.015$ with a filament on one side. Vitellaria two, compact, oval glands one on either side in posterior most part of the body.

Excretory bladder Y-shaped with arms anastomosing dorsal to oral sucker.

DISCUSSION

Chauhan (1953) in the comprehensive work on the family Hemniuridae maintained the genera *Progonus* and *Ophiocorchis* synonyms of the genus *Genarches* and transferred their species under it. Yamaguti (1958) synonymised the genus *Ophiocorchis* Srivastava, 1933 (*Progonus* Looss, 1899, Preoccupied; *Genarches* Looss, 1902 Preoccupied) with *Genarchopsis* Ozaki, 1925.

Srivastava (1933) described *Ophiocorchis singularis* from the intestine of *Channa marulius* at Allahabad. Gupta (1951)

collected some specimens from (hanna punetatus at Lucknow and Saharanpur, U.P. and referred them to as nw species *Ophiocorchis indicum*. Chauhan (1954) remarked that the differences enumerated by Gupta do not merit the establishment of a new species and the two species should be considered indetical.

The present speciments have been collected from Wallago Bleckkeri from a pond at Rahta, in district Jalaun (U.P.) and combine the characters of both the species. Thus, it is evident that *O. indicum* is conspecific with *O. singularis* as suspected by Chauhan (1954). The present collection, however, forms a new locality recorded.

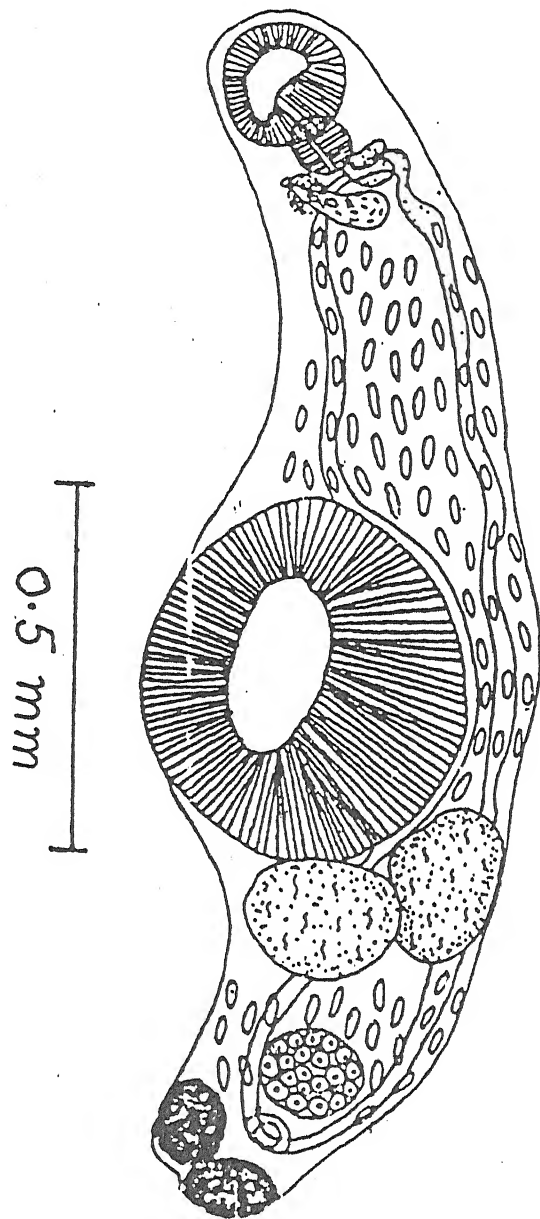


Fig. 11.

Genarchopsis singularis Srivastava, 1933; Ventral view

Genarchopsis goppo Srivastava (1933)

Host	: <u>Rita rita</u>
Locality	: Pond at Shahpur (Banda)
No. of Fishes Collected	: 198
No. of Fishes Infected	: 2
Location	: Intestine
No. of Specimens Collected	: 1 + 1 = 2

DESCRIPTION

Body elliptical with both extremities rounded and measuring 3.6 - 4.89 x 1.07 - 1.9. Maximum breadth in acetabular zone. Oral sucker oval, subterminal 0.32 - 0.36 x 0.39 - 0.44. Pharynx oval, 0.17 - 0.4 x 0.17 - 0.20. Acetabulum large, spherical, equatorial, 0.79 - 0.85 x 0.79 - 0.87.

Testes oval, postacetabular, almost at the same level, right measuring 0.25 - 0.31 x 0.45 - 0.47 and left 0.35 - 0.36 x 0.44 - 0.45 respectively. The cirrus sac absent. Vesicula seminalis well developed, long, cylindrical, postbifurcal, lying free in parenchyma which continues into oval, compact pars prostatica surrounded by

prostate gland cells. Terminal part of pars prostatica joins with metraterm to form hermaphroditic duct. Genital pore submedian in level with pharynx.

Ovary oval, post-testicular, $0.16 - 0.30 \times 0.4 - 0.38$ lying just below right testis. Shell gland complex postovarian. Receptaculum seminis uterinum present. Metraterm well developed, muscular, receiving pars prostatica at its distal end. Eggs with filament on one side. Vitellaria two lobed glands partly overlapping the intestinal caeca, lying in hind part of body.

Excretory bladder Y-shaped with the arms anastomosing dorsal to oral sucker.

DISCUSSION

Srivastava (1933) described the type species *Progonus lobata* (Srivastava, 1933) from the stomach of *Channa straitus* from Lucknow. Gupta (1951) described *Genarchopsis farugis* from the intestine of *Mastacembelus armatus* which is considered as synonym of this species in the light of the variations observed.

G. malanosticus Dwivedi, 1965 and *G. cuchial* Kakaji, 1969 are considered co-specific with *P. lobata* as the characters used by them to differentiate their new species fall within the limit of variations.

The present specimens have been collected from Rita rita from the pond of shahpur Banda, The present collection, forms a new locality recorded.

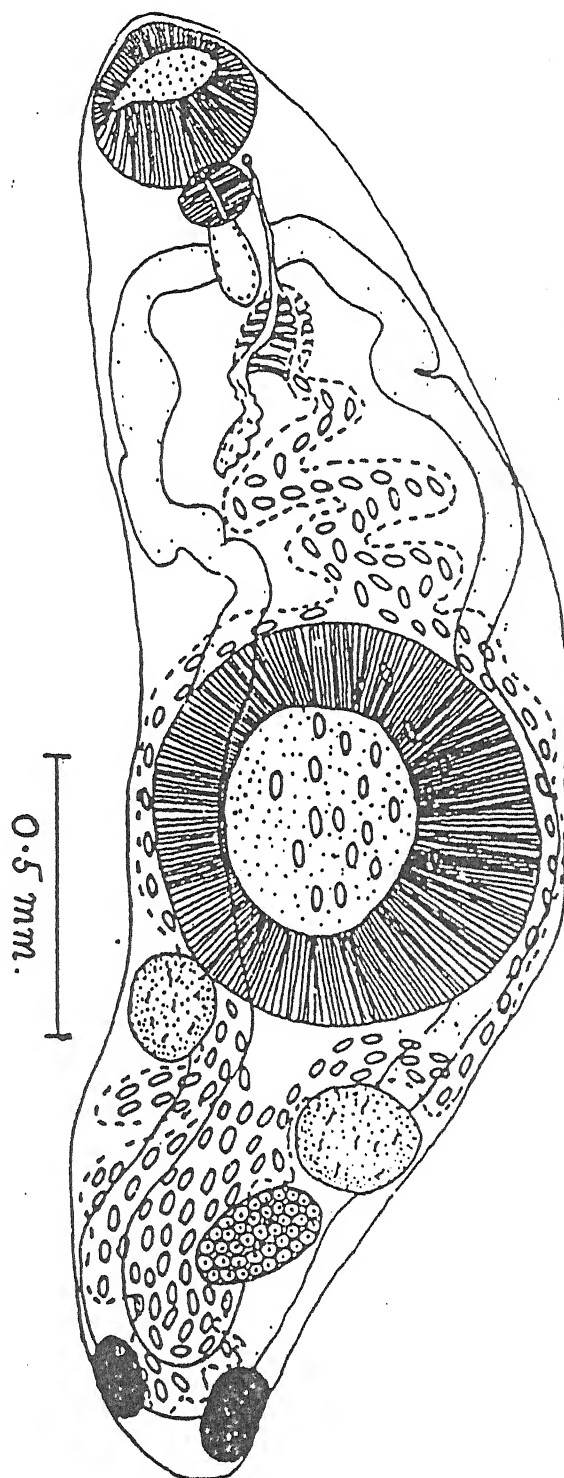


Fig. 10.
Genarchopsis goppo Srivastava, 1933; Ventral view.

Orientocreadium betuaensis

Host	: <u>Heteropneustes fossils (BI)</u>
Locality	: Betwa (Jhansi)
No. of Fishes Examined	: 170
No. of Fishes Infected	: 4
Location	: Intestine & Gall Bladder
No. of Specimens Collected	: 4 + 5 + 2 + 4 = 15

DESCRIPTION

Body spionose, small, elongated measures 1.6 - 1.9 x 0.27 - 0.37. Maximum width being in pre-equatorial region. Oral sucker sub-terminal, rounded 0.10 - 0.13 x 0.12 - 0.13. Prepharynx present, measures 0.02 - 0.05 in length. Pharynx spherical, muscular, measures 0.09 - 0.11 x 0.010 - 0.12. Oesophagus very small or absent. Intestinal caecae terminate at posterior extremity. Acetabulum spherical, pre-equatorial, 0.14 - 0.18

Tested sub-median, transversely elongated, tandem, postequatorial, oval with entire margin, measures 0.12 - 0.17 x 0.07 x 0.07 - 0.12 and 0.13 - 0.19 x 0.07 - 0.12 respectively. Cirrus

sac large, crescent shaped, 0.22 - 0.33 in length situated to the right of the acetabulum enclosing pear shaped vesicula seminalis, well developed pars prostatica, long, spined ejaculatory duct and pretruncable cirrus. Well developed coiled vesicula seminalis externa situated in between acetabulum and ovary. Genital pore preacetabular, submedian.

Ovary median, postacetabular, transversely elongated, situated midway between acetabulum and anterior testis, oval, 0.08 - 0.11 x 0.06 - 0.09. Shell gland complex posterolateral to ovary. Receptaculum seminis absent. The Laurer's canal present uterus very extensive, occupying the whole postacetabular space with descending and ascending coils. Vitellaria consists of large number of follicles, extending from posterior border of acetabulum to posterior end of the body. Eggs numerous, yellow, oval, operaculated, 0.023 - 0.034 x 0.011 - 0.016 mm in size.

DISCUSSION

The present species combined the characters of

Orientocreadium indicum as well as *O. pseudobagri* but has its own distinctive features. It differs from the both in having small body, transversely elongated ovary and testes, very small oesophagus, eggs rounded or oval.

Thus the present form differs from all other species. It is, therefore, regarded as a new species and thus a new form *Orientocreadium betwaensis* has been added by the author in the present work.

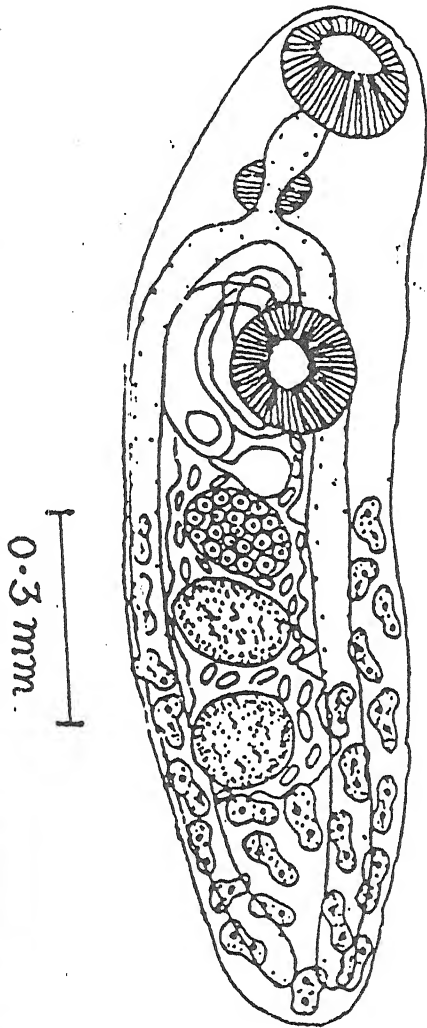


Fig. 3.

Orientocreadium batrachoides Tubangui, 1931; Ventral view

Orientocreadium pseudobagri Yamguti, 1934

Host	: <u>Heteropneustes fossils</u> (BI)
Locality	: Betwa
No. of Fishes Examined	: 160
No. of Fishes Infected	: 3
Location	: Intestine
No. of Specimens Collected	: $2 + 3 + 2 = 7$

DESCRIPTION

Body spindle shaped, spinose with rounded anterior end and bluntly tapering posterior extremity, measures $2.8 - 3.10 \times 0.53 - 0.55$. Oral sucker is simple, subterminal, oval, $0.12 - 0.14 \times 0.14 - 0.17$. prepharynx is short. Pharynx comparatively large, oval, $0.038 - 0.09 \times 0.13 - 0.14$. Oesophagus long, measures $0.33 - 0.39$. Intestinal caecae long and reach nearly upto posterior extremity of body. Acetabulum spherical, pre-equatorial $0.16 - 0.18$.

Testes postequatorial, entire, oval or spherical, subequal or equal, tandem and measuring $0.17 - 0.20 \times 0.19 - 0.21$ and $0.18 - 0.20$. The vesicula seminalis externa and vesicula seminalis interna

are present. Vesicula seminalis externa occupies expanded basal part of the cirrus pouch and is elongated and oval in shape; vesicula seminalis interna is short, retort shaped, lies in front of ovary. The cirrus pouch is crescent shaped, running close to acetabulum on its right side. Opening into genital atrium. Genital pore is preacetabular, submedian and postbifurcal.

Ovary is pretesticular, round to oval, median, lies between acetabulum and anterior testis and measures 0.16 - 0.17. Shell gland complex behind the ovary. Uterus extends up to hind end of the body. Eggs numerous, oval, yellow, $0.020 - 0.026 \times 0.005 - 0.008$. Vitelline follicles extend from the mid acetabular region up to the hind end of body beyond the post-testicular region.

Excretory bladder is wide with terminal excretory pore.

DISCUSSION

Tubangui (1931) created the genus *Orientocreadium* as and placed it under the family allocreadiidae and later (1933) under the subfamily *Allocreadiinae* McMullen (1937) erected the family

Macroderoidae which was accepted by La Rue (1957) and Mehra (1966).

Yamaguti (1958) created the subfamily *Orientocreadiinae* to include the genera *Orientocreadium* and *Macrotrema* under the family *Allocreadiidae*. In the present work the family Allocreadiidae has been accepted.

Yamaguti (1958) has described 12 species under the genus *Orientocreadium*. The present specimens compare well with *Orientocreadium pseudobagri* Yamaguti, 1934, except some minor individual variations like oval oral sucker, small prepharynx, long oesophagus and extension of vitellaria halfway between the caudal testis and posterior tip of the body and cirrus pouch on the right side of acetabulum instead of overlapping it. These variations may be considered as individual variations, so the present specimens are referred to as *O. pseudobagri* Yamaguti, 1934.

This is the first new locality record of this species.

Orientocreadium indicum Pandey

Host	: <u>Mystus bleekeri</u>
Locality	: Ralhai (Jhansi)
No. of Fishes Examined	: 87
No. of Fishes Infected	: 2
Location	: intestine
No. of Specimens Collected	: 3 + 2 = 5

DESCRIPTION

Body small, elongated, spinose with rounded anterior and bluntly tapering posterior extremities, measuring 1.2 - 2.5 x 0.24 - 0.34, maximum width being in preequatorial region. Oral sucker spherical, subterminal, 0.08 - 0.13 x 0.10 - 0.13. Well developed prepharynx is present, 0.05 - 0.09 in length, followed by muscular pharynx 0.08 - 0.10 x 0.09 - 0.11. Oesophagus very small. Intestinal caecae long, reaching upto posterior end. Acetabulum spherical, pre-equatorial, almost equal to oral sucker, measuring 0.13 - 0.19.

Testes median, post-equatorial with entire margin, measures 0.14-0.19 x 0.09 - 0.14 and 0.15 - 0.21 x 0.09 x 0.09 - 0.14

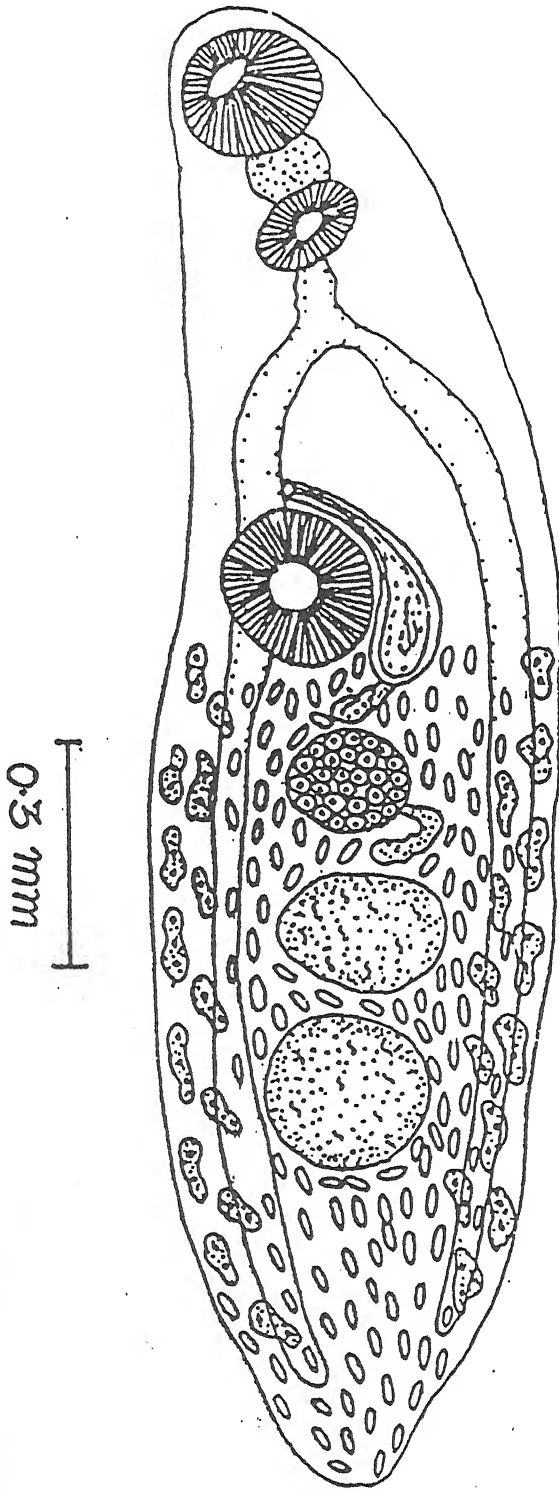


Fig. 5.
Orientocreadium pseudobaqri Yamaguti, 1934, Ventral view.

Orientocreadium indicum Pandey

Host	: <u>Mystus bleekeri</u>
Locality	: Ralhai (Jhansi)
No. of Fishes Examined	: 87
No. of Fishes Infected	: 2
Location	: intestine
No. of Specimens Collected	: 3 + 2 = 5

DESCRIPTION

Body small, elongated, spinose with rounded anterior and bluntly tapering posterior extremities, measuring 1.2 - 2.5 x 0.24 - 0.34, maximum width being in preequatorial region. Oral sucker spherical, subterminal, 0.08 - 0.13 x 0.10 - 0.13. Well developed prepharynx is present, 0.05 - 0.09 in length, followed by muscular pharynx 0.08 - 0.10 x 0.09 - 0.11. Oesophagus very small. Intestinal caecae long, reaching upto posterior end. Acetabulum spherical, pre-equatorial, almost equal to oral sucker, measuring 0.13 - 0.19.

Tests median, post-equatorial with entire margin, measures 0.14-0.19 x 0.09 - 0.14 and 0.15 - 0.21 x 0.09 x 0.09 - 0.14

respectively. Cirrus Sac large, spined, crescent shaped to the right of acetabulum, 0.24-0.32 in length, enclosing pear shaped vesicula seminalis externa in between ovary and acetabulum is present. Genital pore submedian, preacetabular.

Ovary median or submedian, postequatorial, situated midway between acetabulum and anterior testis, spherical, 0.09 - 0.12 x 0.06 - 0.10. Receptaculum seminis is absent, Laurer's canal is present. Uterus extensive, occupying the whole postacetabular space, terminating in metraterm, opening in genital atrium. Vitellaria extend from the anterior border of ovary to posterior end of the body, where the follicles of the two sides meet. Eggs numerous, oval, operculate, yellow 0.030 - 0.36 x 0.010 - 0.017.

Excretory bladder extending upto posterior margin of testes, excretory pore terminal.

DISCUSSION :

Pande (1934) described the new species *Orientocreadium indicum* from the intestine of *Rita buchanani*

from river Gomati at Jaunpur, Uttar Pradesh. This specis differed from type species *O. batrachoides Tubangui*, 1931 by the presence of spined cirrus and metraterm, spherical ovary instead of oval, maximum width in pre-equatorial region, vitellaria extending from posterior margin of acetabulum of posterior end of body where the follicles of two sides meet without forming lattice.

Yamaguti (1954, 1958), Saksena (1958, 1960), Gupta (1961) and Khalil (1961) accepted it as a valid species. Fischthal and Kuntz (1963) also accepted *O. indicum* as a valid species, characterised by the presence of spined cirrus and metraterm, the characters lacking in *O. batrachoides* and completely overlooked by Beverley - Burtan. Thus *O. indicum* is a valid species.

The present material forms new host and locality record. For the first time the specimen has been recorded from a number of the fish *Wallago bleekeri*.

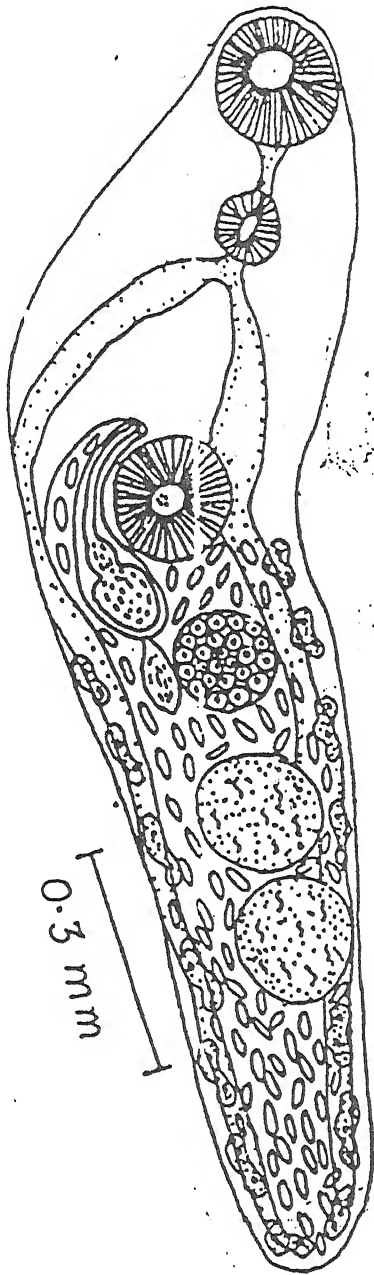


Fig. 4.

Orientocreadium indicum Ponde, 1934; Ventral view

Genarchopsis piscicola Srivastava, 1933

Host	:	<u>Rita rita</u>
Locality	:	Ponds of Nandpura (Hamirpur)
No. of Fishes Examined	:	180
No. of Fishes Infected	:	4
Location	:	intestine
No. of Specimens Collected	:	$2 + 2 + 2 + 2 = 8$

DESCRIPTION

The body is small fusiform, aspinose, muscular and measures $1.26 - 2.62 \times 0.47 - 0.89$. The oral sucker is subterminal, cuplike and measures $0.32 - 0.40 \times 0.32 - 0.50$. Acetabulum is large, postequatorial, well developed, muscular, almost spherical, measuring $0.60 - 0.87 \times 0.61 - 0.87$. The præpharynx is absent. Pharynx present, small and measures $0.11 - 0.13 \times 0.02 - 0.19$. Oesophagus absent, intestinal caecae long and sinuous, extending upto posterior margin of body where they unite.

Testes oval, postacetabular, slightly obliquely tandem, extracaecal and anterior testis measures $0.24 - 0.37 \times 0.17 - 0.28$

and posterior testis $0.24 - 0.37 \times 0.17 - 0.33$, respectively. The cirrus sac absent. Pars prostatica is tubular and convoluted. The ejaculatory duct is short and opens along with metraterm into a short hermaphroditic duct.

Ovary small, postacetabular, intercaecal, spherical, situated almost at the level of posterior testis and measuring $0.15 - 0.23 \times 0.12 - 0.33$. The uterine coils are intercaecal, extending posteriorly upto the hind border of the testes. The left vitelline follicles measure $0.12 - 0.33 \times 0.9 - 0.42$, while right follicles measures $0.18 - 0.52 \times 0.07 - 0.28$. The genital pore just below pharynx near the intestinal bifurcation.

DISCUSSION :

Looss (1899) erected the genus *Progonus* for *Mulleri* levinsen, 1881. He (1902) renamed it as *Genarches* thinking the name *Progonus* as preoccupied by the insect genus *Pronotal* Berg. 1886. Fuhmann (1904, 1928). Odhner (1905) considered *Progonus* as valid. Ozaki (1925) proposed a new genus *Genarchopsis* to accomodate his new species *G. goppo*.

Srivastava, H.D. (1933) while accepting the name *Progonus* valid, considered the genus *Genarchopsis* as synonym of the former. He also erected a new genus *Ophiocorchis* to accommodate his new species *O. labatum*. Yamaguti (1958, 1971) considered the genera *progonus* *Genarches*, *Ophiocorchis* as congeniric with *Genarchopsis*. The former two being, in his opinion, preoccupied. This arrangement is more or less being followed by the subsequent workers. Rai (1971) made a detailed study of various Indian species related to the genus *Ophiocorchis* and *Genarches* and came to the conclusion that all Indian species are synonyms of *G. goppo* Ozaki, 1925. He, however, did not deal with the question of the validity of the genus *Progonus*. Srivastava, H.D. and Shaha (1978) tried to revalidate the genus *Ophiocorchis*. The genus *Progonus* is not preoccupied as generally believed. According to Article 56 of International Rules of Zoological Nomenclature, the genera *Genarchopsis*, and *Ophiocorchis* have, therefore, been related to the genus *Progonus*.

The termatode under discussion has been compared with

the valid species of genus *Genarchopsis* Ozaki, 1925 namely *G. ovacaudatum*, *G. piscicola* and *G. dasus*. It differs from *G. ovacaudatum* in the length and maximum width of the body size of ovary, ratio of suckers and extension of uterine coils. It also differed from *G. dasu* (Gupta, 1951) in the length and maximum width of body length and width of oral sucker ratio of suckers and measurement of vesicula seminalis.

However, the worm approaches more closely to *G. piscicola* Srivastava, 1933 in the extension of uterine coils and principal body measurement, except for the differences in the length of the body, the ratio of suckers and the nature of the uterine coils. These variations are minor ones and do not suggest the proposition of a new species and so the present worms are referred to as *Genarchopsis piscicola* Srivastava, 1933.

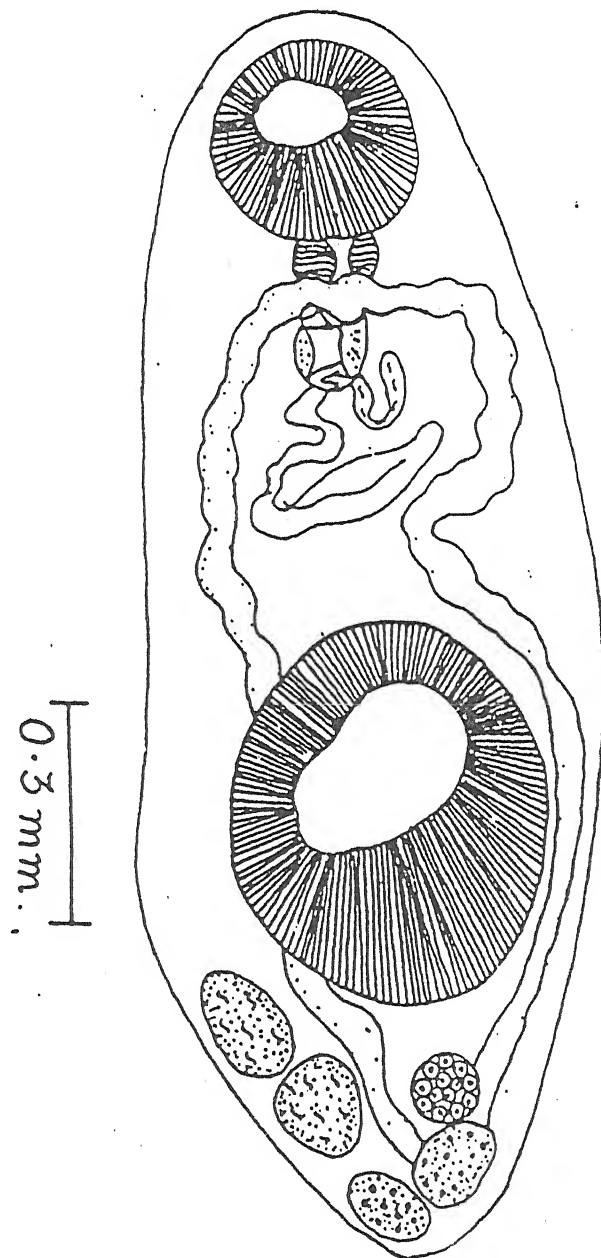


Fig. 9.

Genarchopsis piscicola Srivastava, 1933; Ventral view.

Oneutocreadium batrachoides, Tubangui 1931

Host	: <u>Heteroprieustes fossils</u>
Locality	: Pond of Ralhia (Jhansi), Yamuna
No. of fish examined	: 42
No. of infected	: 3
Location	: Intestine
No. of Specinum Collected	: 3 + 3 + 4 = 10

Description :

The body is spinose, elongated, spindle shaped, with rounded anterior and blunt posterior end, measure 1.586×0.32 . The maximum breadth is at the level of anterior testis. Oral sucker is subterminal, rounded and measures 0.14×0.15 . Acetabulum is submedian, rounded and measures 0.14×0.15 roughly equal to the oral sucker. Prepharynx is large, measures 0.017×0.045 . Pharynx is well development, measures 0.078×0.082 . Oesophagus is very small. Intestinal caecae are simple, long, terminating at posterior extremity.

The testes are rounded, entire, sub-equal, tandem, postequatorial, measuring $0.13 - 0.15 \times 0.028 - 0.025$. Cirrus sac is

long, curved, lying lateral to acetabulum and extends well behind it. It contains a vesicula seminalis interna, pars-prostatica and cirrus. Vesicula seminalis externa is long, saccular. Male and female genital opening are separate, preacetabular and median.

Ovary is oval, pretesticular, equatorial, intercaecal, lying between acetabulum and anterior testis and measures 0.12×0.26 . Receptaculum seminis is present. Vitelline follicles extend from the level of ovary upto hind end of the body. In post-testicular region, the follicles of two sides merge together. Eggs numerous, oval and measures 0.18×0.011 .

Excretory bladder is tubular with terminal excretory pore.

Discussion :

The genus *Orientocreadium* was established by Tubangui in 1931 to include *Orientocreadium batrachoides*, parasitic in *Clarias batrachus* (Linn.). In 1934, Yamaguti added *Orientocreadium indicum* from *Rita buchanani* and *Orientocreadium Pseudobagri* from *Pseudobagri aurantiacus*. He considered the genera *Ganda* Chatterji, 1933; *Neoganada* Dayal, 1983 as synonymous with the genus *Orientocreadium* and also transferred their species under it.

The type species *Orientocreadium batrachoides*

Tubangi has been described in details by many workers with little variations. These include Beverley - Button (1962) from *Clarias mossambicus* and *Clarias mellandia*; Fishthal and Kuntz (1963), Kakaji (1969) from *Rita rita*; Pandey (1971) from *Ophiocephalus punctatis* and Jain and Chandra (1977) from *Channa punctatus*.

Yamaguti (1958) has described twelve species under the genus *Orientocreadium*. *Orientocreadium otto* has been considered a synonym of *O. batrachoides* Tubangui, 1931.

This species has not been described from this locality, it is recorded herein.

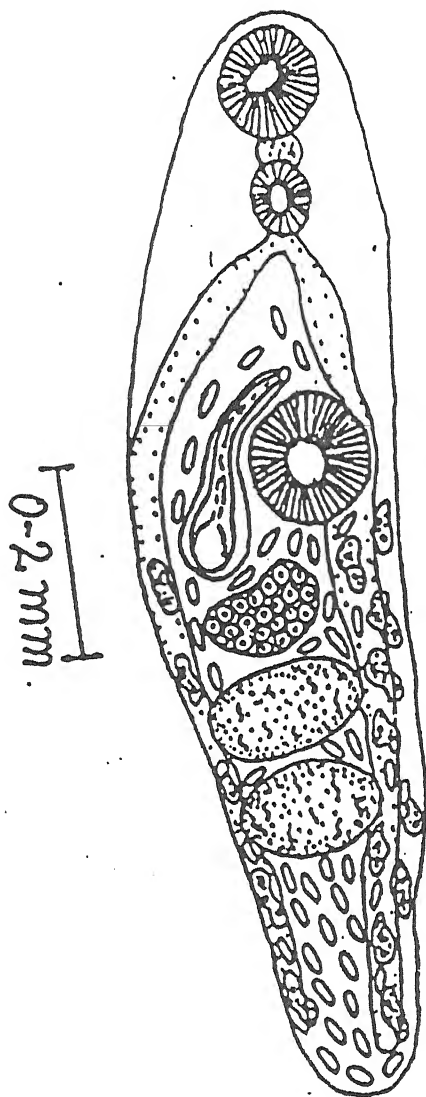


Fig. 6
Orientocreadium betwaensis n.sp.
ventral view.

Allocreadium handiai Pandey, 1937Host : Clupisama gorua

locality : Betwa (Jhansi).

No. of Fish examined : 258

No. of Fish infected : 2

Location : intestine

No. of specinum collected : $2 + 2 = 4$ **DESCRIPTION :**

Body small to large, asinpose, elongated with rounded anterior and posterior extremities, measures $0.75 - 2.8 \times 0.28 - 0.53$ Oral sucker subterminal, spherical, measure $0.15 - 0.24 \times 0.13 - 0.24$ Prepharynx absent. Pharynx oval, muscular, $0.05 - 0.09 \times 0.05 - 0.09$ in size. Oesophagus moderately long, $0.05 - 0.13$ Intestinal bifurcation between pharynx and genital pore and caeca extend a little anterior to posterior extremity overlapped by vitellaria. Acetablulum spherical, smaller than oral sucker, pre-equatorial, measures $0.07 - 0.15$ in diameter.

Testes obliquely tandem, median, spherical or oval, postacetabular, intercaecal, Anterior testis smaller than posterior testis and measures $0.03 - 0.24 \times 0.05 - 0.24$. Posterior testis

measures $0.078 - 0.25 \times 0.05 - 0.24$. Cirrus sac oval to club shaped, situated in between intestinal bifurcation and acetabulum, measures $0.08 - 0.18 \times 0.03 - 0.11$. Vesicula seminalis bipartite.

Ovary small, oval, submedian or median, attached to acetabulum, measures, $0.05 - 0.17 \times 0.04 - 0.10$. Receptaculum seminis and Laurer's canal present. Shell gland complex large, uterus pretesticular. Vitellaria consists of large number of follicles extending from posterior body and almost confluent in post-testicular region.

Excretory bladder tubular extending upto posterior border of posterior testis. Eggs large, yellow, oval embryonated, filamented and measures $0.07 - 0.10 \times 0.03 - 0.05$.

Discussion :

This species has been described by Pande (1937) from the intestine of *Channa punctatus* from Handia, Allahabad and Halwani. Kaw (1950) recorded this species from some other vertebrates. Coil and Kuntz (1960) described it from intestine of *Channa punctatus*

from Dacca (Bangla Desh).

Eight species have been described under the genus *Allocreadium* Looss, 1902 from India These include - A.

annundalei Southwell, 1913, *A. handiai* Pandey, 1937; *A. Kosia* Pande, 1938; *A. schizothoracis* Pande, 1938; *A. nemachilus* Kaw, 1950.

A. thapari Gupta, 1950; *A. mehrai* Gupta, 1950; *A. mehrai* Gupta; *A kamalai* Gupta, 1956. *A. thapari* Gupta, 1956; *A. ophiocephali* Srivastava, 1980 and *A. mukundi* Gupta, 1963. Mehra (1956) considered *A. thapari* and *A. ophiocephali* conspecific with *A. handiai*.

From the study of these specimens it is observed that there is variation in the shape of the body (small and oval or large and elongated), in the size of two suckers, the position of testes (varying from very close to acetabulum to midway between acetabulum and hind end of the body), the position of ovary post acetabular or lateral to posterior half of the acetabulum and in the anterior extension of vitellaria half upto acetabulum or posterior to it. All these have been considered to be individual variations and the specimens are referred to as *Allocreadium handiai* Pande, 1937.

This species have been recorded for the first time from a number of fresh water fishes - *Clarias batrachus* (Linn.), *Heteropneustes fossilis* (Bl.), *Channa punctatus* (Bl.) and *Channa striatus* (Bl.) procured from Betwa river in district Jhansi, thus it forms multiple host and new locality record.

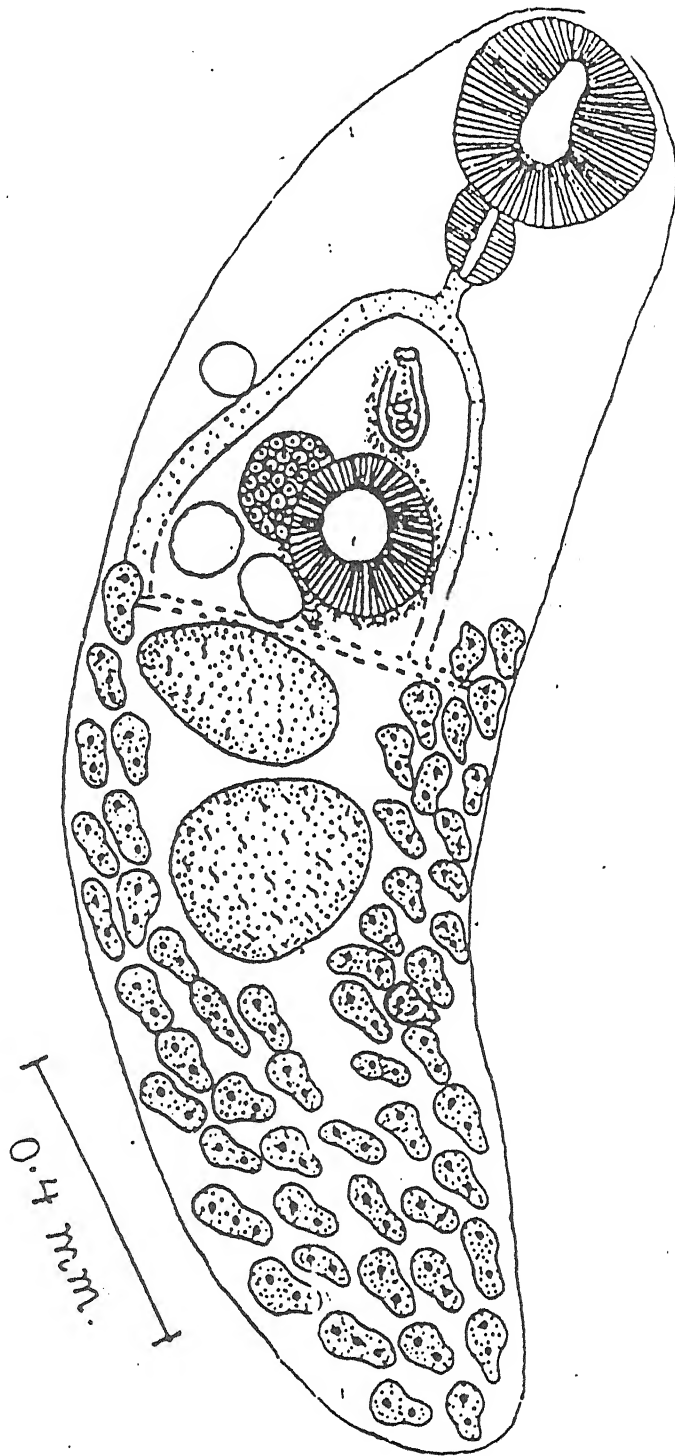


Fig. 2.

Allocreadium handiai Pande, 1937; Ventral view.

Phyllodistomiun tripathi Motueani & Srivastava, 1961

Host : Mystus tengara
Locality : Patoda lake (Lalitpur)
No. of Fish Collected : 70
No. of Fish Inteeted : 6
Location : intestine
No. of Speinen Collected : $2 + 2 + 4 + 3 + 1 = 12$

DESCRIPTION :

The body is aspinose, flask shaped divisible into a narrow tubular fore body and a foliate hind body with wavy margin and measure 1.63×2.31 mm in length and maximum width. 0.75×1.21 mm just behind the posterior margin of acetabulum. Oral sucker is terminal, rounded, measures $0.208 - 0.320 - 0.210 - 0.318$ in size, Acetabulum is larger than oral sucker, intercaecal, circular and measures $0.298 - 0.380 \times 0.241 - 0.380$ in size. Prepharynx and pharynx are absent. Mouth directly leads in to oesophagus. Oesophagus is tubler, measure $0.149 - 0.715$ in length and

bifurcates into two simple, unbranched intestinal caeca, which extend upto hind region of body.

The testes are two in number, deeply lobed, intercaecal, postequatorial, obliquely tandem, placed in the expaned part of the body. They are more or less equal and measures 0.216×0.242 in Size. Cirrus saois absent. Seminal vesicle is saccular, postbifurcal, intercaecal and anterior to acetabulum. Testes are separated by uternie coils.

The overy is pretesicular, postacetabular, intercaecal, lobed, overlaps the right vitellaria and measures $0.098 - 0.210 \times 0.136 - 0.325$ in size. Receptacu um seminis is absent Uterus with descending and ascending limbs, occupy intertesticular, post-testicular area, intercaecal and extracaecal. Its terminal part forms a muscular metranterm. The genital pore is situated behind the intestinal bifurcation, preacetabular, intercaecal, post bifurcal, pre-equatorial. The eggs are numerous, oval, operaculated, both embryonated and unembryonated, measure $0.014 - 0.016$ mm in size.

Vitellaria consist of two lobed glands, lying behind the ventral sucker on each side of the body.

The excretory bladder is sigmoid with terminal excretory pore.

Excretory pore is near posterior end of the body.

DISCUSSION :

Genus *Phyllodistomum* was erected by Braun (1899) with *Phyllodistomum folium* (Olfeers, 1816) Braun, 1899 as the type. The parasites of this normally inhabit the urinary bladder and also the intestine of fishes. It is observed that the forms recorded from urinary bladder are invariably larger.

A total of 15 species (13 from fishes and 2 from amphibians) of the genus *Phyllodistomum* have been reported from India.

A complete list has been given by Thomos (1958) and a key to Indian species by Gupta (1953). Rai (1971) has critically reviewed the Indian species of the genus *Phyllodistomum* and according

to him the various species can be divided into three groups on the basis of relative size of oral sucker and acetabulum. The relative size of suckers, oral and ventral, is a specific character and is least variable in the species. Accordingly i.e. equal size of both suckers - *P. loossi* kaw, 1950; acetabulum smaller than oral sucker - *P. vachius* Dayal, 1949; *P. vittatusi* Gupta, 1953; *P. chauhani* Motwani and Srivastava, 1969 and acetabulum larger than oral sucker - *P. simili* Nybelin, 1926; *P. lewisi* Srivastava, H.D. 1938; *P. singhaii* Gupta 1951; *P. tripathi* Motwani and Srivastava, C.B. 1961 are described as valid species.

The present specimen in the collection of the author has acetabulum distinctly larger than oral sucker. *P. simili* Nybelin, 1926; *P. tripathi* Motwani and Srivastava 1961; *P. folium* Braun, 1899 exhibit this relative structure of suckers. The author is in agreement with Kakaji (1969) in considering *P. tripathi* Motwani and Srivastava, 1961 as a synonym of *P. folium*, as the presence or absence of notch on the posterior end of the body and relative size of various organs except the suckers are variable characters.

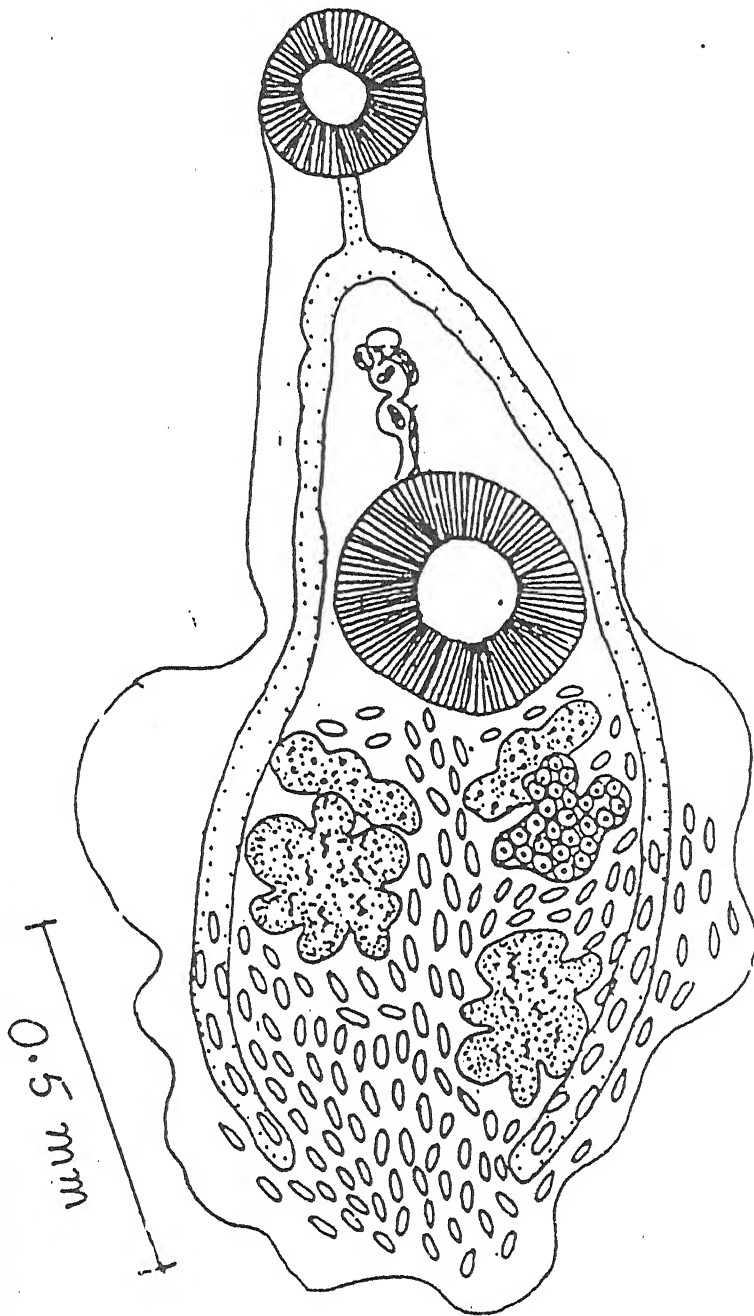


Fig. 7.

Phyllodistomum tripathi Motvani and Srivastava,
1961; Ventral view.

PART - II
SECTION-B
KEY TO LETTERING
IN FIGURES

SECTION-B

KEY TO LETTERING IN FIGURES

AC	Acetabulum
AS	Anterior sucker
AT	Anterior testis
C	Cirrus
CA	Common atrium
CS	Cirrus sac
CVD	Common vitalline duct
EB	Excretory bladder
ED	Ejaculatory duct
EG	Egg
EP	Excretory pore
GA	Genital atrium
GG	Genital gland
GP	Genital pore
IC	Intestinal caecum
INT	Intestine
LC	Laurer's canal
O	Ovary
OD	Oral diverticulum
OP	Oral pouch
OVD	Oviduct
OES	Oesophagus

OESB	Oesophageal bulb
OS	Oral sucker
PG	Prostate gland cells
PH	Pharynx
PP	Pars prostatica
PPH	Pre-pharynx
PT	Posterior testis
RS	Receptaculum seminis
S	Peduncle
SG	Shell glands
SP	Spines
SV	Vesicula seminalis
SVE	Vesicula seminalis externa
SVI	Vesicula seminalis interna
T	Testis
TEN	Tentacle
UT	Uterus
VIT	Vitelline follicles
VITD	Vitelline duct
VITR	Vitelline reservoir
VS	Ventral sucker

PART - III

**HOST PARASITE RELATIONSHIP
SUMMARY
REFERENCES**

HOST-PARASITE RELATIONSHIP

Study of helminthological literature from India indicates that more attention has been paid to taxonomic studies of helminth worms. While the taxonomy forms the basis of all biological investigations, still it alone can not fulfill the objectives of parasitologists. Host-parasite relationship has to be given due weightage to assess the exact extent of damage caused by these parasites. Till now very little attention has been given to host-parasite relationship, population biology and estimation of helminth infection with regard to most of the species. These lacunae are mainly responsible for our failure in implementing our objectives and in combating helminth infections.

In order to make the faunistic studies more objective host-parasite relationship has been studied and discussed in detail. Investigations on these relatively less explored branches are bound to reveal important clues for a correct understanding of the nature and extent of their pathogenic role.

A parasite is always under the influence of two types of environments - viz; the internal environment in which the parasite lives and the external environment in which the host lives. It is the interaction of the influence of these environments and the strategy adopted by the parasites to counter influence that develops the host specificity and host-parasite relationship. Thus the establishment and survival of helminths in their hosts is controlled by the internal environment of the host as well as its external environment.

Thus the major environmental factors that influence the incidence of helminth infection and host-parasite relationship are both biotic and abiotic. In the present study various abiotic factors including - Index of total helminth infection in trematodes, host-wise analysis, overall incidence, level and intensity of parasitization, seasonal incidence have been studied and statistically analysed, similarly biotic factors like the influence of sex of the host and size of the host have also been studied.

The climate of this region is subtropical and the seasons

which can be recognized are the Winter season (Nov., Dec., Jan., Feb.) summer season (March, April, May, June) and Rainy season (July, Aug., Sept., Oct.)

The average atmospheric temperature ranges from 25.11°C (in Jan) to 41.35°C (May) and minimum temperature ranges from 10.51°C (in Jan.) to 26.58°C (May). The temperature gradually shows a decreasing trend from July to December and increasing trend from January to May.

Relative humidity is more in morning (8.30 am) than in evening (5.30 pm). The minimum in morning hours was 24.90% in April while maximum 85.35% was in the month of August. In the evening the lowest humidity values were 16.50% in May and highest 85.33% in August.

Since during the present study period trematodes formed the predominant helminth parasites, hence the present study is mainly concentrated on the host-parasite relationship of trematodes. As the cestode recovered was only one, and no nematodes were reported, so they are not being statistically analysed.

Under the present project, the helminth parasites of ten different host fishes viz. - *Heteropneustes fossilis*, *Pseudentropius artherinnoides*, *Clupeomagus rita*, *Mystus seenghala*, *Mystus oar*, *Mystus tengra*, *Mystus cavasius*, *Mystus bleekeri* and *Mystus vittatus* were collected from Jan. 2003 to March 2005. A total of 1800 host fishes were collected and examined regularly during the period. On an average fifteen fishes of each host species (Total about 75 fishes per month) were examined. The data thus collected has been statistically analysed.

SUMMARY

To investigate helminth parasite from the cat fishes of Bundelkhand region, the author under the present project have used different varieties of cat fishes, Most commonly available in this region. These fishes are affected by different helminth parasite and these parasite causes the damage to visceral parts of the body.

In the present study the digenetic trematodes of cat fishes are reported from different regions of Bundelkhand which includes in both M.P. & U.P. The areas of investigation are Banda, Hamirpur, Jalaun, Jhansi, Lalitpur, Chhatarpur, Datia, Panna & Tikamgarh. The cat fishes of river like Betwa, Dhasan, Ken, Pahuj, Urmi & Yamuna; reservoirs like Arjun dam, Devendra sagar dam, Mandaha dam, & lakes like Barawasagar, Belatal & Rathtal. were examined for helminth infection during the course of research. These are several types of cat fishes belonging to family *siluridae*, different genus of cat fishes are *Heteropneustes fossilis*, *Pseudentropius artherinoides*, *Clupisoma qorua*; *Rita rita*, *Mystus oar*, *Mystus tenara*, *Mystus seenghala*, *Mystus oar*, *Mystus tengra*, *Mystus*

cavasius, Mystus bleekeri Mystus vittatus.

A total ten species of cat fishes belonging to the family Siluridae has been examined. Though, collections of trematode, cestodes, nematodes, & acanthocephalans have been made but only the digenetic trematode are presented in the thesis entitled "studies on the morphology, anatomy and Taxonomy of digenetic parasite of cat fishes of Bundelkhand. The trematode have been studied in living condition & fishes stained mounts. The thesis includes the description of 23 species of digenetic trematode of fishes. The description of each new species has been followed by a discussion to establish the claims of its being new species with a Key of the species under genus. Further a general introduction, a brief historical review of Indian literature pertaining to the digenetic trematodes of the fresh water fishes of India, materials & method, Physiography of Bundelkhand region, climatic conditions, have also been given in the beginning of dissertation. A list of references, consulted during the course of present investigation & those having direct bearing on the text, has been given at the end of the thesis.

Soon after collection the trematodes were studied alive to observe spines or papillae in any, excretory system and genital opening. They were then fixed in 5-10% formaline, after fixation and through washing in water, worms were dehydrated in alcoholic series, then stained in borex carmine, cleared in xylene and finally mounted in DPX.

For preparing whole mounts of trematodes, the worms were relaxed in fresh water for some time. The body was gently stretched by adding luke warm water. kept in alcoholic series, stained in aceticalum carmine, cleared in clove oil and finally mounted in canada balsum or DPX.

The work incorporated in the present thesis is divided into three parts.

Part I deals with introduction, historical resume, material and method, a systematic list of host examined Physigraphy of Bundelkhand region and map bordering distric of Bundelkhand region.

Part II deals with the taxonomic grouping of Twenty three including three metacercarial forms recovered during the study period. Mention has not the part of project. Out of these trematode species, seven species has been described as new species whereas remaining sixteen are redescribed in details, furnishing further information and observations which were essential to enrich our knowledge on these parasites. They are known form but majority of these form the first host and locality record. These digenetic parasite & their families are described as follows :-

Opisthorchis pedicellata Verma, 1927: Location: Galla badder; Host: ***Bagarius bagarius*** (Ham.); Locality : River Ken Panna, M.P. and River Betwa, Orachha, Tikamgarh, M.P. It is redescribed. It differs from the original account of Verma, 1927 in the ratio of suckers and in the extension of vesicula seminalis and vitelline follicles.

Tremiorchis ranarum Mehra and Negi, 1926 : Location : Intestine; Host : ***Rita rita*** (Ham.); Locality : Fish market Hamirpur, U.P. It is redescribed. The present form slightly differs from earlier

description in various measurements, in the length of oesophagus and in extension of *vitelline follicles*. *Rita rita* (Ham.) is recorded as an additional piscine host.

Allocreadium mahaseri Pande, 1938: Location : Intestine; Host : *Mastacembelus armatus* (Lac.); Locality : Benisagar, Panna, M.P. It is redescribed and slightly differs from the earlier description in the shape of gonads, in extension of cirrus sac and in the position of genital pore.

Allocreadium mahaseri Pande, 1938 : Location : Intestine; Host : *Mastacembelus armatus* (Lac.); Locality : Benisagar, Panna M.P. It is redescribed and slightly differs from the earlier description in the shape of gonads, in extension of cirrus sac and in the position of genital pore.

Phyllodistomum vittatusi Gupta, 1953 : Location : Intestine; Host : *Puntius sarana* (Ham.); Locality : Fish market Rath, Hamirpur, U.P. It is redescribed and slightly differs in the size of oesophagus and testes being larger than ovary.

Opisthorchis bandai n. sp. : Location : Gall bladder; Host: ***Bagarius bagarius*** (Ham.); Locality : Fish market Banda, U.P. The present form comes closer to *O. pedicellata minuta* in having small pre-pharynx, short oesophagus and further resembles with *O. pedicellata* , *O. gorokhpurensis*, *O. dayali* in the extension of in the extension of intestinal caeca but differs from all other known species in the extension of vitelline follicles and cuticular spines.

Pseudoparamacroderoides keni n. sp. : Location : Intestine; Host : ***Mystus vittatus*** (Bl.); Locality : River Ken, Panna, M.P. It differs from the other known species in the extension of vitelline follicles and by having comparatively very short oesophagus. (An abstract of this species is published in 69th Indian Science Congress held at Mysore from 3rd - 8th January, 1982. No. 295 124.)

Oudhia kanungoi n. sp. Location : Intestine ; Host : ***Rita rita*** (Ham.) ; Locality : River Betwa, Hamirpur, U.P. Fish market Jhansi, U.P. It differs from the other known species in the ratio of suckers, in extension of vitelline follicles, in the position of gonads & genital pore & also in extension of cuticular spines.

Dactylostomum mastacembeli n. sp. : Location : Intestine; Host : ***Mastacembelu*** armatus (Lac.); Locality : Belatal, Hamirpur M.P. It is distinguished from the other known species in having two dactyles on the ventral sucker and in position of genital pore except *D. Jhansienis*. An abstract of this species is published in 51st Annual Session of National Academy of Sciences, India held at Cochin from 5th - 7th October, 1981. Abs. No. 149, pp. 53.

Neopodocotyle mohantalensis n. sp. : Location : Intestine; Host ; ***Channa punctatus*** (Bl.) ; Locality : Mohantal, Kulpahar, Hamirpur, U.P. The present form differs from other known species by having oral sucker larger than the ventral sucker and in the position of ovary and genital pore.

Bundelatrema orchhaensis n. sp. : Location : Liver ; Host: ***Puntius sarana*** (Ham.) ; Locality ; River Betwa, Orachha, Tikamgarh, M.P. It is distinguished from the other know species in having a short pre-pharynx, ratio of testes, in the extension of vitelline follicles and uterus. An abstract of the extension of published in 6th Indian Science Congress held at Mysore from 3rd to 8th January,

1982. Abs. No. 264 pp. 110.

Faustula cirrhinusi n. sp. : Location ; Intestine ; Host : ***Cirrhinus mriala*** (Ham.) ; Locality : Devendrasagar dam, Panna, M.P. The present form comes closer to ***F. clupii*** but differs from it in the extension of vitelline follicles and in having even lobed ovary.

Phyllodistomum vittatusi Gupta, 1953 : Location : Intestine; ***Puntius saran*** (Ham.) ; Locality : Fish market Ratch, Hamirpur, M.P. It is redescribed and slightly differs in the size of oesophagus and testes being larger than ovary.

Orientocreadium batrachoides Tubangui, 1931 : Location: Intestine ; Host : ***Clarias batrachus*** (Linn.) ; Locality : River Yamuna, Hamirpur, U.P. It is redescribed. However, it slightly differs from the earlier account.

Genarchopsis goppo Srivastava, 1933 has been conected from the intestine of ***Channa puctatus*** (Bl.). It is characterised by ellipitcal shape of the body, acetabulum large and spherical. Cirrus sac absent. Vesicula seminalis well developed,

vitellria two lobed glands.

It forms the first host and locality record.

Genarchopsis singularis Srivasatava , 1933 has been described from the intestine of ***Channa punctus*** (Bl.) and ***Channa striatus*** (Bl.). It is characterised by small oesophagus, symmetrical testes, cirrus sac absent and two compact vitellaria.

The parasite forms the first host and locality record.

Orientocreadium indicum Pande, 1934 has been described from the intestine of all the five host species under the present project. It is characterised by the presence of spined cirrus and metraterm, spherical ovary, vitellaria extending from posterior margin of acetabulum to posterior end of the body and the follicles of two sides meet without forming lattice.

It forms the first host and locality record.

Orientocreadium pseudobagri Yamaguti, 1934 has been recorded from the intestine of two species viz - ***Clarias***

batrachus (Linn.) and *Heteropneustes fossilis* (Bl.). It is oesophagus and extension of vitellaria halfway between the caudal testis and posterior tip of the body and cirrus pouch on the right side of acetabulum instead of overlapping it.

It forms the first host and locality record.

Orientocreadium betwaensis n. sp. has been collected from the intestine of two host species viz *Clarias batrias* (Linn.) and *Heteropneustes fossilis* (Bl.). This new species is

Genarchopsis piscicola Srivastava, 1933 has been recorded from the intestine of *Channa punctatus* (Bl.). It is characterised by small and fusiform body. Oral sucker cuplike, acetabulum.

Allocreadium handiai Pande, 1937 has been recorded from the intestine of four host species excluding *Channa marulius* (Ham.). It is characterised by the shape of the body, acetabulum smaller than oral sucker, tandem testes and small ovary attached to acetabulum.

It is the first host locality record from District Mathura (U.P.).

Orientocreadium batrachoides Tubangui, 1931 has been collected from the intestine of *Claia batrachus* (Linn.). It is characterised by receptaculum seminis, pretesticular,

Phyllodistomum tripathi Motwani and Srivastava has been recorded from the intestine of *Heteropneustes fossilis* (Bl.). It is characterised by acetabulum distinctly larger than oral sucker, wavy margins having thick folds along with margins, flask shaped body, divisible into a narrow, tubular fore body and a foliate hind body. Prepharynx absent, deeply lobed testes, cirrus sac absent, lobed ovary overlaps the right vitellaria. Receptaculum seminis absent, vitellaria two lobed glands.

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